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CONTENTS:

PAGE
SHALL WE TRUST JAPAN? ... 505
THE PEKING SCHOOL OF JOURNALISM ... 508
THE RACIAL ISSUE ... 509
America's Supremacy in Rubber Manufacture ... 510
RAILWAY ELECTRIFICATION IN JAPAN ... *511
IRRIGATION IN INDO-CHINA... *517
HYDRO-ELECTRIC DEVELOPMENTS IN N.E.I. ... *521
REINFORCED CONCRETE BRIDGES IN CHINA... *524
JOHORE CAUSEWAY ... *526
PENANG'S HILL RAILWAY ... *530
NORTH BORNEO ... *536
INDUSTRIAL SURVEY OF TURKESTAN... *539

PAGE
CONSERVANCY WORK IN NORTH CHINA ... *541
CHINA'S COTTON INDUSTRY.—I ... *546
A Small Light and Power Plant... *550
MUNICIPAL GOVERNMENT IN CHINA ... *551
AMERICAN TIN DREDGING IN MALAYA... *552
REFRIGERATION AND STORAGE OF FOOD ... *553
THE PROGRESS OF SCIENCE AND ENGINEERING IN JAPAN *558
JAPAN'S ELECTRICAL DEVELOPMENT ... *560
Frazar & Company Expands ... 563
THE STAFF OF LIFE IN THE FAR EAST ... *564
RIVER IMPROVEMENTS IN JAPAN... *566
Shimonoseki-Moji Tunnel ... 568

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Bliss Co., E. W. 27
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British Mannesmann Tube Co., Ltd. 41
Browning Co., The 31
Brunswick-Kroeschell Co. 4
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Chartered Bank of India, Australia & China 48
Codem Book Co. 72

Dai-Ichi Ginko 62
Dai Nippon Brewery Co. 72
Diamond State Fibre Co. 72
Dixon Crucible Co., Joseph 74
Dodge Bros. 5
Dorman Long & Co., Ltd. 3
Drewry Car Co., Ltd. 19
Drysdale & Co., Ltd. 72

Electricity Department, S. M. C. 4
English Electric Co., Ltd. 13
Escher Wyss & Cie. 73
Evans & Sons (Wolverhampton), Ld., Joseph 2

Fairbanks Morse & Co. 33
Fuji Gassed Spinning Co. 10

Gleniffer Motors, Ltd. 14
Goodbrand & Co. 43
Goodell-Pratt Co. 65
Green Island Cement Co., Ltd., The 20
Greene Tweed & Co. 65
Greenfield Tap & Die Corp. 19
Greening & Sons, Ltd., N. 72

Heap & Co., Ltd., Joshua 53
Hongkong Rope Manufacturing Co. 20
Hongkong & Shanghai Banking Corporation 59
Hongkong & Whampoa Dock Co., Ld. 30
Hotel Statler Co. 63
Humber, Ltd 16

Imperial Japanese Government Railways 68, 69
Industrial Bank of Japan 58
International Banking Corporation 55
International General Electric Co., Inc. 51

Japan Sugar Co., Ltd. 6
Jardine Engineering Corporation, Ltd., The 12
Jones & Lamson Machine Co. 53
Jugo Ginko 56

Kanegafuchi Spinning Co., Ltd. 10
Kawasaki Dockyard Co., Ltd. 35
Kellogg Switchboard & Supply Co. Under Index
Kokusai Kisen Kaisha 45
Koster Co., The, Cover

London Directory Co., Ltd. 61
Low & Sons, Ltd., Archibald 17

Manning, Maxwell & Moore, Inc. 64
Mather and Platt, Ltd. 16
Matthews & Yates, Ltd. 42
Metropolitan Vickers Electrical Co., Ltd. 76
McClintic-Marshall Products Co. 27
McConway and Torley Co. 39
Mitsubishi Bank 57
Mitsubishi Iron & Steel Co., Ltd. 38
Mitsubishi Marine & Fire Ins. Co., Ld. 38
Mitsubishi Shoji Kaisha 18
Mitsubishi Warehouse Co. 38
Mitsubishi Zosen Kaisha, Ltd 36
Mitsui Bank 57
Mitsui Mining Co. 18
Mitsui Bussan Kaisha 26
Morse & Son, Inc., A. J. 61
Motor Rail & Tram Car Co. 41
Mustard & Co. 39

New Engineering & Shipbuilding Works 34
New Imperial Cycles, Ltd. 33
Nippon Menkwa Kabushiki Kaisha 50
Nippon Yusen Kaisha 46, 47
Nobel Industries, Ltd. 22

Okura & Co. (Trading), Ltd. 24
One Hundredth Bank, Ltd., The 59

Pooley & Son, Ltd., Henry 2

Redpath Brown & Co., Ltd. 64
Royal Bank of Canada 61
Ruston & Hornsby, Ltd. 42

Sale & Frazar, Ltd. 8
Shanghai Dock & Eng. Co., Ltd 32
Shanghai Municipal Council 4
Siber Hegner & Co., Ltd 11
Simons & Co., Ltd., Wm. 14
Smith Major & Stevens, Ltd., 7
South Manchuria Railway Co. 66, 70, 71
Standard Oil Co. of N. Y. 29
Standard Underground Cable Co. 65
Sturtevant Co., B. F. 7
Sulzer Bros. 568
Sumitomo 60
Sumitomo Bank, Ltd. 60
Superheater Co., The 19

Thornycroft & Co., Ltd. John I. 1
Toshin Soko 40
Toyo Kisen Kaisha 43
Trimont Manufacturing Co. 9

United States Steel Products Company 23, 37, Back Cover

Walworth International Co. 76
Wharton, Jr. & Co. Inc., Wm. 21
Whittall & Co., Ltd., J. 6
Wild & Co., Ltd., M. B. 9
Williams & Co., J. H. 17

Yarrow & Co., Ltd. Cover
Yokohama Dock Co. Ltd. 33
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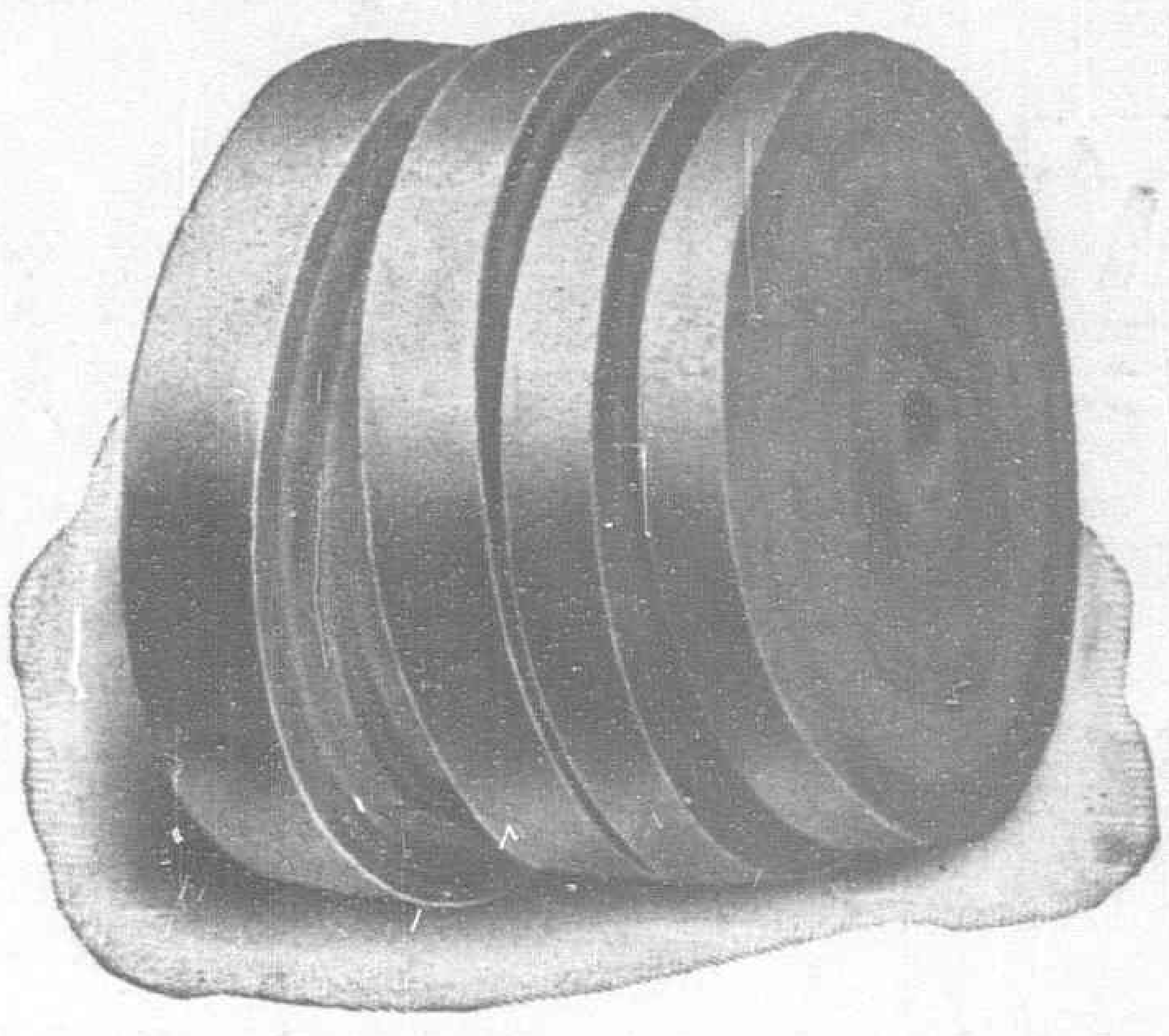

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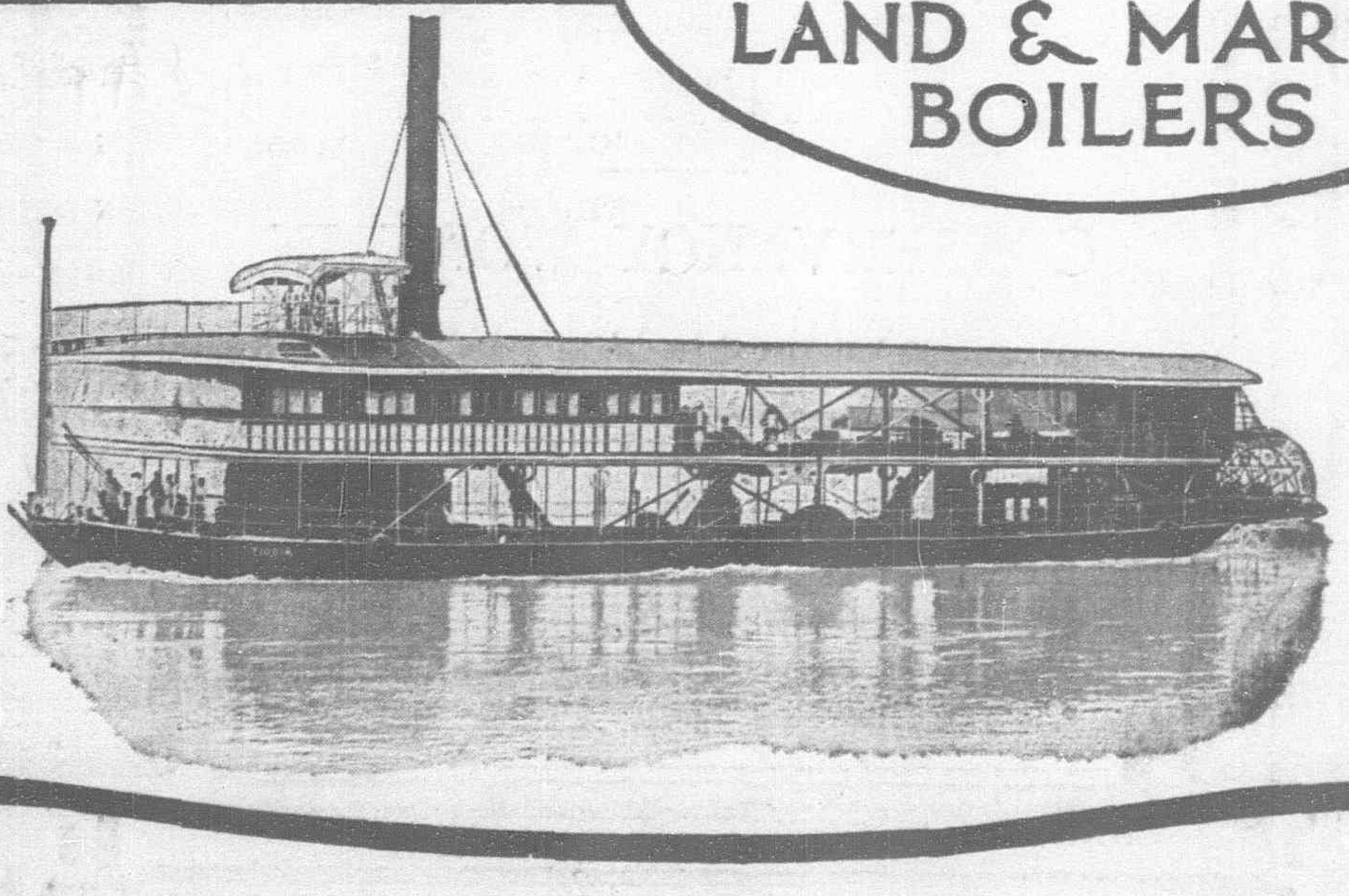

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Twenty-ninth President of the United States of America
Born, November 2, 1865. Died, August 2, 1923

The Far Eastern Review

ENGINEERING FINANCE COMMERCE

VOL. XIX SHANGHAI, AUGUST, 1923 No. 8

Shall We Trust Japan?

By Franklin D. Roosevelt

Reprinted from the July Issue of "Asia"

That an assistant secretary of the navy, none of whose chief duties during a large part of his term of office was to prepare to fight Japan, can now write as Mr. Roosevelt does in this plea for a pacific attitude on the part of the United States toward Japan, must bring a new conviction of the possibilities for a permanent and increasingly strong bond of friendship. Mr. Roosevelt was assistant secretary not only before and during the world war, but also after the armistice. It was then that the policy of building the greatest navy in the world—to be prepared for the immediate contingency of a possible war with Japan, while the Anglo-Japanese alliance was still in effect—was being rapidly put into operation. Treaties, ententes, friendship societies have their place in an expression of good feeling between nations; but, when the naval men of one land sincerely recognize a spirit of honest goodwill in the naval men of another, there is usually reality behind it.—EDITOR'S NOTE.

* * *

WHY do so many Americans, after witnessing the devastation and the futility of war, continue to think of Japan and the Japanese in terms of war? Why have so many Japanese a similar mental attitude toward the United States? Is this mutually apprehensive habit of mind, to whatever understandable origins it may be due, justified to-day?

It must be noted that, up to 1898, relations between the United States and Japan had been largely sentimental. We justly believed that we had been instrumental in awakening Japan to western civilization. Japan seemed to be appropriately grateful for the more abundant life thus opened to a formerly hermit nation. The awakened Japanese government sent its picked sons to us for education in the new methods. Among others the future Admiral Uriu, who last summer in Japan entertained his Annapolis classmates and Secretary Denby, came to the United States naval academy. Commercially the two nations were not yet rivals, there were no military points of contact and the Japanese had not yet migrated to California in any large numbers.

There has been, however, an apprehensive habit of mind in both countries for many years. When for the first time, in 1898, the American flag adventured territorially overseas, "imperialism" became a brand-new topic with news value on both sides of the Pacific. Discussion as to the defenses of the new insular possessions of the United States began immediately thereafter in military and naval circles and spread thence to the newspapers, which gave to the whole subject an exaggerated importance. Anti-imperialists used the threat of taken-for-granted Japanese aggression to bolster up their otherwise academic arguments. So, too, the Japanese, finding a new and pushing western power in their southern back yard, used the new American developments following the Spanish-American war, with the presumably changing foreign policy contingent thereupon, as a sufficiently obvious argument for popularizing naval expansion.

During the next decade both nations expanded enormously in naval armament and Pacific commerce. In 1904—1905 Japan defeated Russia and by the peace of Portsmouth overflowed with military rule, colonization, railway development and manufactured goods into Korea and Manchuria. And, to make the situation more delicate, our own Pacific coast, adding political irritation to commercial jealousy and growing suspicion, developed a "Japanese Peril."

What more natural than that the two nations should begin to consider the possibilities of war? Outside the executive departments at Washington it has never been known in this country that, during ten nervous days in the early summer of 1908, the United States hovered on the edge of an ultimatum from Japan. Yet long before the events of 1914 centered attention elsewhere, an American-Japanese war was the best bet of the prohets. Its imminence began to be taken for granted. Responsible journalists, not only in America but in Europe as well, alluded to it as merely a question of time. To-day, in 1923, although the much anticipated war is not even seriously considered, many people in both nations cling to the old habit of mind.

But has not the time come to change our hypothesis? The feeling of the past was largely a natural result of new alinements and new problems. In international affairs novelties are apt to arouse suspicion. We have not forgotten the apprehension awakened in England and in Australia by Japanese naval operations in the Pacific archipelagoes in 1914—1915. More recent experience presents the vivid example of the general consternation caused all over Europe and, to a lesser degree, in this country, by the phoenix-like rise of the Turkish nationalists under Kemal and the consequent changes in the political map of the Levant. As for the mutual distrust that has undoubtedly been characteristic of Japan and the United States during recent years, I am firmly convinced that it was the perfectly logical outcome, not of any one cause, but of a series of almost inevitable causes based on new conditions, which were practically forced on both governments. The question therefore resolves itself into this: Have these cause been, or can they be, sufficiently removed so that a new point of view may be substituted for the old? Can the two nations henceforward base their thoughts of each other on the assumption of peace?

The first answer that occurs—and perhaps the most pertinent—is that the race for naval supremacy has been at least temporarily checked by the Washington conference in 1921. The lifting of the burden of stupendous naval programs was financially important, especially to Japan, and the suspension of competition in the principal types of war-ships has already done something to allay war talk.

To my mind, however, there is another phase of the Washington Conference which, though generally overlooked, has a curiously important bearing upon the future relations of the two major Pacific powers. I refer to what may best be called the naval strategical dead-lock which has been created. After 1898 every high officer in the army and navy of both Japan and the United States, together with many selected junior officers, had spent days and weeks and months in studying what, aside from the question of German imperialistic designs in the western hemisphere, was in this country the cardinal war problem. From my own knowledge, for instance, it may be stated that the general board of the navy and the general staff of the army of the United States, together with the joint board representing both services, used to study with the utmost care the problem of the defenses of the Philippines.

And it may now be said, in reviewing these conferences, that the distance of the islands from our continental shores and the lack of adequate bases on the Pacific coast, in Hawaii, Guam and the Philippines themselves led many officers of both services to admit that in the event of war with Japan the Philippines could not be held. This, remember, was ten years ago, before the extraordinary development of the submarine and of air-craft. The Japanese fleet, to be sure, was at that time numerically far inferior to our own—less than half its paper strength—but military and naval men knew the almost insurmountable difficulties of maintaining a preponderant American fleet in Asiatic waters. The line of communication was too dangerously long. On the purely military side our army experts found an almost hopeless situation. Though the defenses of Corregidor Island in Manila Bay might prevent a repetition of Dewey's exploit of 1898, what could a handful of American troops be expected to accomplish if an invading Japanese army were once landed at almost any other of innumerable practical locations on the coast of Luzon? Nevertheless, just so long as the race of naval armaments continued, our responsible officers of the higher commands continued vigorously to make the best plans possible for the defense of American possessions in the Far East. And these plans, with the jeopardy they implied, were evidences of the need for the appropriations asked in the annual bills presented to congress.

These labors have been, if not terminated, at least materially changed by the Washington conference of 1921. A reorientation, so to speak, of naval matters began with the ratification of the naval treaty by the three ranking naval powers. For the next ten years the American navy is to be roughly as five is to three of the Japanese navy. Furthermore, the United States has agreed not to add any fortifications in the Philippines or in Guam. To say "add" is perhaps a euphemism; for no fortifications now existing there can be, in the light of the last war, seriously considered.

During these earlier years, I remember, the wiser officers and statesmen on this side of the water were convinced that a war between the United States and Japan would have been likely to result in a military dead-lock. For the United States to have held the Philippines would have been, as I have indicated, a scarcely achievable task; for the Japanese to have invaded—or rather to have maintained any invasion—on our Pacific coast would have been an impossible task. If, with a fleet double the size of Japan's and our vastly greater resources, invasion of the western shores of the Pacific was admitted to be probably impossible, certainly impracticable, for us, how much more formidable was the corresponding problem presented to the military strategists of Japan! It must not be forgotten, moreover—the point will bear the emphasis of repetitions—that this impasse was reached before the days of effective submarines and air-craft, and that even at that time, when offensive operations over long sea-distances were less difficult than now, war would, in all probability, have been decided on economic issues. And in these the United States had, and has, a vast superiority.

Nevertheless, public opinion was not then educated to such a point of view and, frankly, no considerable portion of it in the United States yet grasps, I am inclined to think, the essential facts of the military situation. Many of us have not forgotten the real scares during the great war over the possibility of Japanese-German secret bases in Mexico and even in Alaskan waters. If it is probably true that prior to 1921 a strategical naval and military dead-lock existed, it is certainly true that neither Japan nor the United States recognized the fact.

As long as ten years ago naval experts said that a fleet crossing a wide ocean from its home base must of necessity lose from a quarter to a third of its fighting value. If that judgment was true ten years ago, then the principle is even more true to-day; for the addition of two new dimensions, under water and in the air, to the fighting-area has made the protection of the capital ship—super-dreadnought or battle cruiser, the fundamental fighting-unit—a much harder task than it was then. If our naval experts a decade ago doubted whether we could hold the Philippines with a fleet more than twice as powerful as that of Japan, what would they say to-day, when we have a fleet rated as only five to three with that of Japan—in actual efficiency of material and number of personnel the ratio is actually now lower than that agreed upon—and the new instruments of warfare capable of intensive use over a short radius, undeveloped ten years ago, have now been enormously multiplied? And on the other hand, even if Japan in 1914 had any false notion that she could threaten us either through Mexico or by direct invasion of the Pacific coast, it is safe to say that her strategists have now tacitly abandoned such ideas.

Nobody, presumably, after all the prophets of 1914 have been proved without honor in any country, would attempt to say what would happen at the end of a military dead-lock between Japan and the United States. After the first year or two of hostilities economic causes would become the determining factor. Tableau: Japan and the United States, four or five thousand miles apart, making faces at one another across a no-man's water as broad as the Pacific. Some genius might then arise to ask what it was all about and what the use was of the atrophy of national life and development. Or, to take a pessimistic view, jingo counsels might prevail in both nations until one or the other, or both, had bled to death through the pocketbook. If, then, it were realized by the people of this country and of Japan that a war would be a futile gesture, attended by no sufficiently compensating results, each nation might be in a fair way to change its apprehensive habit of mind.

Nearly a year and a half ago the Washington conference terminated its work and signed the naval agreement. Great Britain, Japan and the United States—the three participants chiefly affected by it—promptly ratified it. Since neither of the two non-ratifying powers, France and Italy, entered seriously into the naval situation, there was consequently a gentlemen's agreement or understanding effected impliedly on the part of Great Britain, Japan and the United States whereby the terms of the formal naval treaty should be carried out with the same force as if all five signatory powers had promptly ratified. Great Britain has faithfully lived up to her part of the agreement, a recent attempt to show bad faith, in the matter of alterations to capital ships such as to permit an increase elevation and consequent greater range of turret-guns, having been proved (March 22) entirely without grounds. Japan, contrary to her tactics on certain past occasions, has lived up not only to the letter but to the spirit of the treaty. Premier Hara, in sending his delegation to the Washington conference, emphasized the chance thus afforded his nation and government to become established on a new basis of faith. Under the leadership of Premier Kato, the government has seized this opportunity. It has indeed been at pains to show the highest form of *bonâ fides* in connection with the engagements entered into at Washington, even though each and every one of the terms to which the Japanese delegates subscribed involved some national sacrifice, of prestige, of political ambition, of dignity.

With regard to the scrapping of capital ships, the peculiar situation in which Japan's chief delegate and present Premier found himself has escaped due appreciation. Kato, Admiral Kato, it must be remembered, is the creator of the Japanese navy. When therefore as a member of the big three of sea-power he was called upon to vote for drastic naval disarmament, and later on obliged as premier to carry out to the letter his national undertaking, he was performing a renunciatory act far more searching than the colder statesmanship of Mr. Hughes or Mr. Balfour. Kato and his colleagues, at the instance of a rival naval power, that power whose naval rivalry was most immediately threatening to Japan, were called upon to destroy what he himself had patiently created and built up during sixteen years of serious political and financial difficulties.

Kato proved himself capable of that great gesture and, what is more important, capable also of the less dramatic performance. The scrapping of naval vessels condemned by the treaty has gone forward faster in Japan than in this country. The historic naval base at Port Arthur, endeared to the Japanese by every consideration of national sentiment, has been abandoned, and the larger one on the Japanese mainland at Maizuru has also been dismantled. It may be contended that neither of these stations has great strategical value, but this is an open question. In any event, the Japanese have carried out their pledge.

On July 2, 1922, the Japanese withdrew their garrison of five hundred men from Hankow on the Yangtze and on October 26 of last year evacuated Siberia, according to their treaty engagements, with the last of a division which approximated twelve thousand men. About a month later, on or about November 22, they gave up their radio station on Russian Island, Siberia. Later, on January 1, to be exact, they gave up all their post-offices in China with the exception of those retained along the line of their South Manchuria railway. This was precisely according to agreement.

It may be remembered that the Chinese delegates at Versailles refused to sign the peace document because of the reservation to Japan therein of the German rights and claims to the sacred province of Shantung. Japan's signature to the peace was contingent upon that reservation. Shantung was expressly the *sine qua non* of Japanese adherence to the peace of Versailles. Shantung was the gist of the twenty-one demands. And yet on September 14, 1922, Japan withdrew from Shantung, handing over everything to the Chinese, in accordance with her Washington pledges, amid the astonished contemplation of the journalists of the world and of the dumfounded Chinese themselves. Joint administration of the railroad was continued as agreed upon. In this latter case of very material sacrifice the irreconcilables point out that Japan in reality gained in the long run more than she lost in Shantung. A Chinese boycott had crippled her trade in this, one of the richest provinces in the republic, these critics explain, and Japanese policies and ambitions in Shantung were rapidly stirring up a national resentment throughout China. However that may be, the fact remains that the Kato administration has carried out to the letter in Shantung what Admiral Kato signed to do at Washington.

These, then, are the facts. It seems a pity that our own government has failed to enlighten the ignorance of the nation on matters of such vital importance. I do not hesitate to say that such thousands of American citizens as give these interests any thought at all are at this moment wondering whether Japan has been, or is, carrying out her vast naval building program as announced after the war. What a difference in popular sentiment might have occurred, and might still occur, if the true facts had been promptly and widely made known to the public! If our government would spend half the energy in disseminating this healing kind of information that it wastes in creating misapprehensions about its own policy, the whole country would benefit thereby materially and morally. Once upon a time, not so many years ago, the government of the United States was a professed believer in open diplomacy. I am told that those times have changed. I begin to believe that they have changed when I realize that one of the most magnificent opportunities any government ever had has been allowed to slip during the past year.

Possibly the delay in the scrapping of United States ships as provided for and pledged in accordance with the treaty may lie at the bottom of the minimized success of the Washington conference. Japan's determined course as undertaken by her principal representative at the conference, Admiral Kato, won for his government a new and wider respect abroad. Japan's subsequent course at home, under the leadership of the same Baron Kato as premier, has been an exhibition not only of good faith but of a national desire to prove to the world that suspicions of the past are no longer justified.

Now with regard also to the very important question of Japanese and American interests in China, the situation is somewhat improved. The idea of the partition of China, which hung like a cloud on the horizon of two generations of Japanese growth, I regard as having been dissipated, if not forever, then for our own times, by the great war. During these same generations and longer the United States, innocent of territorial ambitions, has been the proverbial friend of China, and American sympathies have been pro-Chinese rather than pro-Japanese. Perhaps, however, we are appreciating now a little more readily than formerly the Japanese point of view. Although to-day the open door, brought into general recognition and pledged at the Washington conference of 1921, is, with the Monroe doctrine, the only definitely expressed foreign policy of the United States, we can now recognize that there is a real necessity to Japan of the markets and the raw products of that part of the Chinese mainland contiguous to her island shores. Here, then, is another valid reason, a generous and a sensible reason, for altering or abandoning the old-fashioned habit of mind.

On the final point and the most delicate, the question of Japanese immigration and property-owning in the United States, it is difficult to write without arousing unreasoning passions on one side or on both. So far as Americans are concerned, it must be admitted that, as a whole, they honestly believe—and in this belief they are at one with the people of Australasia and Canada—that the mingling of white with oriental blood on an extensive scale is harmful to our future citizenship. This belief extends to and affects not only the Japanese, as a race, but other oriental peoples of acknowledged dignity and integrity, such as the Chinese, the natives of the Philippines and the Hindus of India. As a corollary of this conviction, Americans object to the holding of large amounts of real property, of land, by aliens or by those descended from mixed marriages. Frankly, they do not want non-assimilable immigrants as citizens, nor do they desire any extensive proprietorship of land without citizenship.

But the reverse of the position thus taken holds equally true. In other words, I do not believe that the American people now or in the future will insist upon the right or privilege of entry into an oriental country to such an extent as to threaten racial purity or to jeopardize the land-owing prerogatives of citizenship. I think I may sincerely claim for American public opinion in this respect an honest adherence to the Golden Rule. Surely the people of the East will come to realize that we ask of them on their side of the great water no more favorable rule, we expect no lighter restrictions, than we demand in regard to our native sand. Whether this tendency, this reciprocity of thought and policy, shall be expressed in the future through " gentlemen's agreements " or by treaties, it seems to me evident that the atmosphere is slowly clearing and that in this respect also we shall have cause to eliminate another threat to international comity.

Are there any remaining causes of probably offense which might justify a continuance of the old attitude? Yes, one other must be taken into consideration—commercial rivalry in the Pacific. A certain school of international thought has exalted this as the basic cause of all armed conflicts between nations. With this school I most profoundly disagree. Some wars, undeniably, have in large measure been the result of commercial competition. But others have been based upon racial antipathy and still others on pure military aggrandizement, on religious bigotry or on internal revolution. No general rule that will stand analysis can be applied. During the past hundred and ten years, for instance, the United States has been in many respects Great Britain's most serious commercial competitor. Yet these rival nations look back on a record of unbroken peace during all that time.

In the case of Japan it is true that we shall continue to overlap and perhaps to clash in the development of the commerce of the Pacific, but when one considers the potential trade of the vast territories and huge populations bordering the North and South Pacific oceans there would seem to be enough commercial room and to spare for both Japan and us well into the indefinite future. If it is proved that within one great nation co-operation rather than cutthroat competition best fosters an honorable and mutually beneficial trade, why is not the same formula true as between two nations operating in the same broad area? Europe is providing abundant and impressive examples of the contrary. More specifically, reciprocal markets between Japan and the United States appeal to business communities on both sides of the Pacific. Our trade with Japan alone last year was larger than that with all the rest of the oriental field combined. Furthermore, in the great staples of American export, in oil and cotton and tobacco, Japan is not now and will not conceivably become a serious competitor. In manufactured goods, especially the cheaper varieties, Japan, with preferential rates, a subsidized merchant marine and the shorter haul over government-owned lines, has an undoubted advantage on the contiguous mainland of China. But the higher grades of American manufactures continue to hold their own in markets where the Chinese buy for value. Stiff competition in the foreign field will benefit out inflated standards of profit and bring about a more careful study of foreign markets as well as more elastic adaptation to them.

Finally, I believe that we may assume the principal causes of friction in the past either to have been removed or to be on the road to eventual elimination. That status alone, however, is not sufficient. Things cannot remain merely negative. If we eliminate the habit of mind of the past something else, some other habit of mind, must take its place. Therein lies a magnificent opportunity. The United States and Japan came through the world war in better physical and economic condition than any others of the great powers. Their loss in man-power was relatively very small. Their gain in potential world markets and in home resources was correspondingly great. Their national debts, though materially increased, were in part taken care of by their growth in national weatlh. In both countires currency and national credit have remained sound. Both nations are solvent. Most of the rest of the civilized world has been hard hit. Whole populations have been thrown out of great. To-day the school of those who believe that the solvent nations, those who are in a position to help restore the world, must play their magnanimous part, is almost daily receiving accessions of strength. Whether it be from a purely selfish desire for additional prosperity, or whether it rise from the deep belief that we owe a little something to mankind as a whole, the demand for the quieting of the troubled waters is heard on every side.

Shall the United States enter upon this great task for mankind ? If we say " Yes," we must ask further : " Shall we undertake this mission alone ? Is it too big for us ? Can any one else help ? " It is a task of the first magnitude ; of such magnitude that ordinary political gentry stand back appalled. If we accept their ostrich point of view, we shall never begin, we shall never highly dare. We shall miss our great opportunity. But it would seem to be a matter of common sense that, if we once do devote ourselves to this work, we should call in all the assistance available. It is a world undertaking. South America ought to help and, in the light of the Pan-American congress at Santiago, will help; the British colonies should lend a hand. And why, in all reason, should not Japan, shoulder to shoulder with us, provide her aid as well ? If, instead of looking for causes of offense, we in all good faith confidently expect from Japan co-operation in world upbuilding, we shall go far toward insuring peace.

The Peking School of Journalism

A Waste of Money

THE American people are being called upon to endow a school of journalism at the Peking University, and a drive for $500,000 has been opened at its American headquarters in New York. It would seem that the very best way to teach young Chinese the rudiments of modern journalism is through practical work on an existing American newspaper or magazine issued in China. The endowment of a purely national organ in China would ensure the profitable publication of one of the best journals in the Far East for the advancement of national interests and ideals, and at the same time enable a fair number of young Chinese to acquire practical experience essential to their future usefulness.

If the half million gold dollars were employed to establish a real American organ in China with the provision that a certain sum be expended each year in training Chinese university graduates in practical newspaper reporting, and the sponsors of the scheme would lend their influence in encouraging legitimate advertising support to such a medium, the net results to China and America would be far greater than turning out a yearly batch of cub graduates aspiring to editorial honors without having passed through the initial hard stages of reporting.

What the Chinese require in newspaper education can only be learned by practical experience in a well regulated editorial office with a hard-boiled city editor on the desk, enforcing discipline and a regard for facts.

The details of the school of journalism project were drawn up by Dr. J. Leighton Stuart, president of Peking University, before he returned to China a few days ago. As technical advisers, New York newspaper editors and a member of the Columbia School of Journalism conferred with Dr. Stuart, says the *New York Times.*

The endowment estimate includes a provision for traveling fellowships similar to the Pulitzer traveling scholarships granted annually to three graduates of the Columbia School who have made exceptional records. The Peking School of Journalism is to award two two-year fellowships, each carrying a stipend of $1,000 a year, to enable graduates who evince appropriate promise to take advanced studies in universities in the United States and gain first-hand knowledge of American newspaper work, with a view to returning to China better equipped for work on native papers.

The new school, according to the policy outlined, will offer a four-year course leading to a baccalaureate degree. The academic work will centre on general studies, especially political sciince, history, the Engish language, economics and modern commerce, to afford a well-rounded background for editorial work. The technical training is to be provided in actual practice, rather than in academic theory, by establishing contacts between the students and the native newspaper offices in Peking.

Dr. Stuart pointed out that the city offered exceptional opportunities for student editors and writers to gain experience along with their scholastic training. Peking now has about seventy-five native-language daily newspapers, or about double the number published in any other Chinese city, besides many magazines. In all, about 800 dailies are now published throughout China, virtually all of which have been established since the beginning of the anti-monarchical movement which culminated in the revolution of 1911. In 1895, before this movement began to operate, there were only thirty-one native daily papers in China.

There has been no correlative provision for professionl education of the great body of young editors and writers who have come forward with this expansion of the press in China, according to Dr. Stuart. The demand is accentuated by the consciousness of Chinese editors and publishers of a need for informed writers. Dr. Stuart said that Peking University already had students intending to do newspaper work, although no technical instruction was yet offered.

The only university in China now having a department of journalism is St. John's University, in Shanghai. Courses were begun there in 1921, taught by Don D. Patterson, now of the Missouri School of Journalism. While this department serves the central China section, the northern section remains without any journalistic educational facilities.

Dr. Stuart hopes that sufficient funds will be obtained, together with the amounts already in hand for this specific purpose, to open the school in the Fall of 1924. The endowment estimate calls for three professors of journalism, two of whom are to be American University graduates experienced in newspaper work in the United States, and the third a Chinese journalist. The full staff, which probably will not be completed until later than the initial year, is to include two assistant professors.

In the above statement, Dr. Stuart invites attention to the reason why it is difficult to train Chinese into independent journalists, when he points to the exceptional facilities offered by Peking for student editors and writers to gain experience along with their scholastic training. Peking may have seventy-five or more daily newspapers, but exactly seventy-five or more are subsidized organs published in the interest of some party, faction or individual leader. These papers do not seek news. They would not recognize news if they saw it and, when it conflicts with their policy, would not publish it if paid to do so. The practical training to be obtained on such newspapers is not of that order which will tend to develop a high regard for the ethics of the profession. There is little scope for independent thought under prevailing newspaper conditions in China. Few Chinese newspapers are commercial propositions. The Chinese merchant or manufacturer does not advertise or properly support their press, while the subscription rate is so low as to exclude any profit from this source of revenue. It is fair to state that ninety per cent. of the 800 Chinese newspapers exist on official subsidies. Until these conditions are reversed and Chinese newspapers can be run as a business proposition, it will bring no lasting benefits to China or America to spend $500,000 in educating youths who will have to repudiate their ideals in order to exist. The net result will be that nearly every graduate will start his own paper under the patronage of some party or official and with letters of recommendation from the School of Journalism will pester American manufacturers to advertise.

The Racial Issue

Chinese Defiance of American Immigration Laws Threatens to Overshadow the Japanese Problem

TWO days after the Chinese smuggling schooner *Mary Beatrice* was towed into New York with all the marks of a battle royal around her blood-stained decks, Secretary of Labor Davis announced in Washington that over 5,000 Chinese were illegally in New York alone, while Chinese compradores in the know admitted that the total was nearer 10,000. What would have happened had this same number of Japanese laborers evaded our immigration laws and slipped into the Pacific coast states, is better left to the imagination. By this time, America or at least California would have declared hostilities and the war of the races would now be on. The Chinese, as our pet philanthropic recreation, are permitted to do things which we would never tolerate from other peoples. However, the test is coming and more rapidly than people at home imagine.

In the February number of THE FAR EASTERN REVIEW we invited attention to the shifting of the Asiatic problem from the Pacific coast to the Gulf and Atlantic states, reverting to its original anti-Chinese character. At that time it was estimated that over 25,000 Chinese coolies in Cuba, Jamaica, and the Bahamas were patiently waiting their turn to be smuggled across to the promised land at $500 per head. The Gulf states, the first to feel the effects of the new invasion, were even then up in arms and the revenue and immigration services hard pressed to enforce the law.

In addition to this method of flouting our immigration laws, thousands of Chinese are pouring into New York through the loophole provided by a federal court ruling holding that Chinese seamen are entitled to shore leave without the $500 bond formerly imposed. Despite all precautions on the part of the authorities, nearly 6,000 Chinese seamen have deserted while on shore leave scattering into the interior where it is difficult to locate them. The situation became so intolerable that the federal authorities were forced to act and on June 7 made their first raid. Within an hour over fifty Chinese laborers illegally in the country were rounded up in Long Island City while scores of others have since been captured in other metropolitan districts.

This is only the commencement of a problem which is certain to develop into an issue that will have a far-reaching effect upon the relations between America and China. Coolie smuggling is fast assuming even greater proportions than ocean bootlegging. Freebooters are building up a traffic in immigrants in defiance of the legal quota, more profitable even than rum-running. It would take the entire American army to run down the Chinese seamen who violate their shore privileges and a formidable auxiliary have to stop the profitable smuggling of Asiatics by means of fast motor-boats from Mexico, Cuba and other Caribbean islands.

"The total number of Chinese illegally residing in the United States, says Secretary Davis, "can only be ascertained by actual enrollment. To deport those actually in New York Davis would cost over $1,000,000." If such an estimate is correct, then the cost of repatriating the other tens of thousands of Chinese who have seeped into the interior, and whose number can only be roughly estimated, may well ascend to over $10,000,000. President Harding has announced that he will ask the next congress for stringent action to prevent the illegal entry of aliens.

The story of the *Mary Beatrice* brought home to the people of New York the story that is old in the Gulf state ports, and still older on the Pacific coast, where any time these past forty years government officials have been busy trailing a mosquito fleet engaged in bringing in Chinese from lower California at $350 to $800 a head. One ring alone working from Ensenada, Mexico, says a writer in the *New York Times*, is credited with having smuggled into the United States 1,000 coolies a month for several years. The Chinese coolie stoically take chances to get into the forbidden land that white men do not often risk and the stories of these expeditions read like old-time dime novels. These smugglers stop at nothing. If hard pressed they will callously sacrifice their human freight or convoy as the case may be, in order to escape capture.

Yet the Chinese keep coming, undeterred by the hardships and the possibility of losing their lives or of being turned back if caught. No coolie has the cash to pay the high charges exacted by the smuggling gangs. The logical deduction is that he is financed by some central organization which profits from this influx of Chinese labor into America. It is safe to deduce that this organization is exclusively Chinese, the ringleaders of which are to be found in the United States with agents in China, chiefly in Hongkong, Canton or Amoy.

The Chinese have carried with them to America that supreme contempt they hold towards the western conception of law and order. It may be true that the individual Chinese is meek, willing and orderly, but these virtues do not exist amongst their society leaders, who are above American law, discipline and punishment. American hostility to the Japanese arises in part from the difficulty of assimilation and because they retain allegiance to their country. We are prone to overlook in the midst of the avalanche of sentimental propaganda that the Chinese also retain their allegiance to their customs and reject the right of American law to interfere in their internal affairs. The Chinese laborer in America recognizes only the laws of his *tonq* or society rendering it that allegiance and tribute in assessments withheld from the proper authorities. The Chinatown *tonq* wars of New York, San Francisco and other large American cities are beyond the power of the police furnishing ample evidence of a state of affairs which emphasizes the above statement. If further evidence be required it is found in the following New York news item of May 23 ulto. :—

> "The treaty between the Hip Sing and Ong Leong *tongs* to keep the peace of Chinatown has reappeared as strangely as it vanished late last summer. Dr. Carleton Simon, special deputy police commissioner in charge of the narcotic division, turned it over to representatives of the two *tongs* at police headquarters, but refused to say how he had got it. Edward Gong, secretary of the Hip Sings, and Henry Moy, secretary of the Ong Leongs, received it and said they would keep it in the offices of the Chinese merchants' association, where it will remain as a guarantee of peace.
>
> "Elaborate ceremonies attended the return of the document. Ten representatives of the New York Chinese were present. Major-General G. P. Wang, chief inspector of police of Kiangsu province, with headquarters at Nanking, China, was a guest of honor. He urged the Chinese to obey our laws and avoid the traffic in drugs and gambling.
>
> "The treaty was signed eleven years ago. Under it, peace reigned among the Chinese in America until last August, when the treaty disappeared, coincident with the assassination of Dr. Ko Low, president of the Hip Sings. Threats of trouble have been heard since the murder."

Here we have the evidence of the existence of a government within a government, in which assassination and intimidation is employed to settle their inter-society quarrels. The smuggling of narcotics into America is largely controlled by these societies and it is also known that the same gangs are financing the coolie trade in defiance of our laws. Secretary Davis says it would cost a million to deport the Chinese illegally in New York, and when we add to this the sums required to deport those scattered throughout the country and the cost of an efficient immigration service, the tax on the American treasury would wipe out any surplus in the profits we receive from Chinese trade after deducting our contributions for philanthropic uplift. At present, it would seem that the net result to our national economy is written in red ink. If our government should elect to employ the Boxer indemnity as a fund to enforce our immigration laws instead of applying it for further uplift work in China, it would meet with considerable applause from the tax payers.

The present trend of Asiatic immigration must be taken as a reflection of the unstable conditions prevailing in China that are forcing thousands overseas to gain the living denied them in their own country. The Chinese are slowly seeping into and establishing colonies in all countries open to their entrance. An Associated Press dispatch from Papeete, Tahiti, dated May 1, announcing the opening of a new Chinese bank described the tremendous strides the Chinese have made in the past ten years in capturing the trade of these islands.

> "Steadily every industry is passing into their hands—vanilla curing, market gardening, butchering, pearl shell and pearl buying. They are strong in all lines of merchandising, and now have turned their attention to financing their activities through their own banks.
>
> "The history of the Chinese in Tahiti is an illustration of oriental infiltration where there are no laws to limit or prevent it. The French government, owing to a treaty with China, vital to the interests of the great

French colony fo Indo-China, places practically no restrictions on incoming Chinese in Tahiti.

"Originally, Chinese immigrants were brought here as indentured laborers about the time of the American civil war, when a large and flourishing cotton plantation was being operated by English interests. When the price of cotton fell with the close of the war, in 1865, the plantation was abandoned and the majority of the Chinese coolies were returned to their country.

"A few, however, remained, entered business in a small way and gradually, by adapting their methods to those of the natives, obtained a grip on trade. This grip they have strengthened until to-day the European traders view the future with pessimism. Some go as far as to predict that within five years all the commerce of the islands will be in the hands of the Chinese."

The story of Tahiti is the story of all other small countries where the Chinese have gone in large numbers. The world, however, clamors more and more for cheap labor and where the demand is, it is met by China. The problem in the United States is fast developing into one which will overshadow the controversy with Japan, with no prospect of settlement through usual diplomatic procedure. Japan, at least, can exercise some control over her emigration, but in the absence of all authority in China it will be difficult to enter into any agreement with this country relieving the American treasury of the enormous cost of enforcing our laws. At the present rate of development, it will not be many years before the Chinese question will supersede that precipitated by the Japanese in California, and as the years roll on without any solution, the racial issue will once more take precedence over all others. As long as America and Europe stands by and permits Russia to monopolize the waste lands of Asia, forcing the yellow man over the Pacific for his existence, the problem will grow, and the time will come when, to consolidate Russia's hold on vast territories stolen from the Mongolian race, the white races of the Pacific will have to face the issue that should be settled on the plains of Central Asia.

* * *

America's Supremacy in Rubber Manufacture

BECAUSE of certain advantages which it will be hard to overcome, England may remain the largest producer of crude rubber for a long time to come, but America is emphasizing daily her prominence in the field of rubber manufacture.

In the rubber world, one group of scientific men is being watched with the greatest interest. For a number of years this group has been making announcements of important new discoveries with a regularity that has centered the attention of the whole industry upon it. This group makes up what is known as the development department of the United Stated Rubber Company and it is responsible for the development of three new processes which mean more to the rubber manufacturer and to the user of rubber products than anything that has been accomplished in the rubber industry since vulcanization was discovered in 1839.

The three new developments are: (1) Sprayed rubber, for use in the manufacture of all rubber products; (2) Web cord, a fundamental improvement in the art of cord tire making; and (3) a new method of building and vulcanizing cord tires.

Sprayed rubber is produced by a revolutionary new method which eliminates that great bugbear of rubber manufacture, lack of uniformity. Hitherto each rubber grower has transformed his liquid rubber into blocks and sheets by a process of coagulation which called for pouring acids into the liquid rubber or by drying it in smoke.

Needless to say rubber when it reached the factories from the great number of individual plantations was anything but uniform in quality, and there was of necessity a good deal of haphazard work about turning it into useful articles. This lack of uniformity in the raw rubber accounts in part for the fact, so well known to motorists, that one tire would give a phenomenal mileage, while another in the same set, made at the same time, would fall far short of making a satisfactory record. Both went through exactly the same manufacturing process but the lack of uniformity of the raw rubber was partly responsible for the widely varying performances.

Under the acid method of coagulation, which is in general use on the plantations in the Far East where more than eighty per cent. of the rubber comes from, such a small thing as a rainy day might produce a big difference in the quality of the rubber produced. Rain falling into the cups set to catch the rubber as it flowed from the trees would dilute the liquid rubber, and account had to be taken of this dilution when the liquid rubber was put through the coagulation process.

Under the spray process, it makes no difference whether the liquid rubber has been diluted or not. This process extracts from the liquid rubber—latex, as it is called in rubber circles—every atom of rubber. If the latex is rich and full of rubber, the spray process extracts it all. But if the latex is diluted and "thin," the spray process is just as effective and takes out every particle of rubber the liquid contains.

Another very important feature of spray rubber is that it is absolutely pure and of full strength. Rubber coagulated by the smoke process is produced chiefly in the "wild rubber" areas in South America. The workers are natives, unused to the careful, scientific methods required in high-grade manufacture and smoked rubber is frequently filled with impurities such as dirt, sticks and leaves. Acid-treated rubber, as produced on the plantations, has sacrificed some of its strength through contact with the acids and through the manipulation through which it passed before it reached the market. Sprayed rubber is absolutely pure and possesses all the strength of the virgin rubber. Scientific tests show it to have a tensile strength never before equalled by any commercial rubber.

Sprayed rubber may be produced on the plantations and shipped to the United States in blocks or any desirable form, or the latex may be shipped to that country in the tanks of ships and converted into blocks there. Units for making sprayed rubber are in operation by the United States Rubber Company both in America and on the company's large plantations in Sumatra.

While of importance to manufacturers of all kinds of rubber goods, the development of this type of rubber is especially important to tire manufacture, insuring a toughness and uniformity in tread stock and other rubber parts of a tire never before known.

Web cord is the name of a wonderful new cord fabric for tires in which each individual cord has been immersed in rubber latex until it is literally impregnated. Every motorist knows by now that the length of life of his tires depends largely upon the thoroughness with which each cord in the carcass is impregnated and surrounded by rubber, the object of this being to reduce friction.

In making Web cord, the cords are given a latex bath. Cotton absorbs rubber in this new liquid form quickly, so that by the time the bath is completed each cord and every thread in each cord has been saturated with liquid rubber.

As the cords come out of the bath they lie side by side, and the natural adhesiveness of this virgin rubber causes them to stick together. By the time they have dried they form a firm sheet. There are no cross threads whatever, this feature and the thorough rubberization of the cords constituting the essential points of difference between Web Cord and the cord fabric heretofore in use. It is from the fact that there is no cross weave that the fabric gets its name of "Web Cord." Actual use of tire thus made conclusively shows that this fabric makes the strongest and longest wearing tires yet produced.

The essential feature of this process is, of course, that the cords are given a bath in pure latex. This method of treatment should not be confused with the old method of dipping in rubber solution. One of the oldest methods of making tire fabric has been to dip the fabric into a rubber solution made by dissolving crude rubber in benzine or some similar solvent. This old method was not only crude and ineffective, but devitalized the cotton by dissolving out some of the natural oils and waxes.

The third development—a new method of building and vulcanizing cord tires—has a wide significance in tire manufacture, where it displaces the old "cord" method of tire building.

To the tire user it means that the structure of the carcass of the tire is brought very much nearer to perfection than ever before, and that many of the causes of tire break-down have been eliminated.

The new process is called the "flat-band" process of tire building, the name being derived from the fact that under this method tires are built flat and then fashioned into normal tire shape by special machinery, instead of being built to tire shape around a metal core.

The result of the use of the new process is a uniform tire, equalized throughout in resiliency and resistance to wear, in which each cord contributes always its full strength.

Under the old process the human element played an important part in cord tire construction, and there was always the likelihood that in stretching cord fabric around a core by hand there would be a variation in the tension or a departure from the correct direction of the cords. The tension and the direction of the cords are now determined by a machine that makes no mistakes and these two serious opportunities for tires being faulty are eliminated.

Railway Electrification in Japan

The Yoro and Tobu Program

THE Yoro railway line owned by the Ibigawa Denki Kabushiki Kaisha has been electrified from Ogaki on the main Tokaido division of the Imperial Government Railways, to Kuwana on the Kansai division, a distance of 26.8 miles: and from Ogaki to Ibi, a distance of 9 miles, making a total of 35.8 miles of electrified line.

This railway was originally a steam-operated line owned by the Yoro Tetsudo K.K. (Yoro Railway Co.) taken over in 1922 by the Ibigawa Electric Co. Permission was obtained from the authorities last year for its electrification and the construction hurried. As a result, the first electric cars were run over the completed lines in May this year.

By steam, from Ogaki to Kuwana the time was 2 hours, but the new electric cars now make the trip in just half that time. This is one of only two 1,500 volt private electric railways in Japan, the other being the Osaka Railway Co. The Ibigawa Electric Co. has also received permission to build a new electric line, between Kuwana station and Yokkaichi, about ten miles, gauge 3-ft. 6-in., using 45 or 50 pound rails, single track line, using D.C., overhead transmission lines.

The following description of the equipment of the power stations and transformer stations of this railway line is furnished by the company:—

Nishi Ogaki Power Plant

Generators: Maximum capacity 500 kilowatts; average, 150 kilowatts; volts, 555 A.C. 750 D.C.; 6 phase, 60 cycles; 1,800 R.P.M.; two generators, with one in reserve: three in all; two connected, 1,500 volts; manufactured by Shibaura Denki Seisakujo, Tokyo.

Transformers: 150 K.V.A.; first pressure 9,500, 10,000 and 10,500, 11,000 volts; stepped down to 55 volts, single phase; 60 cycles; oil cooled—3 units making one set. 1 unit in reserve; Manufactured by Shibaura Denki Seisakujo.

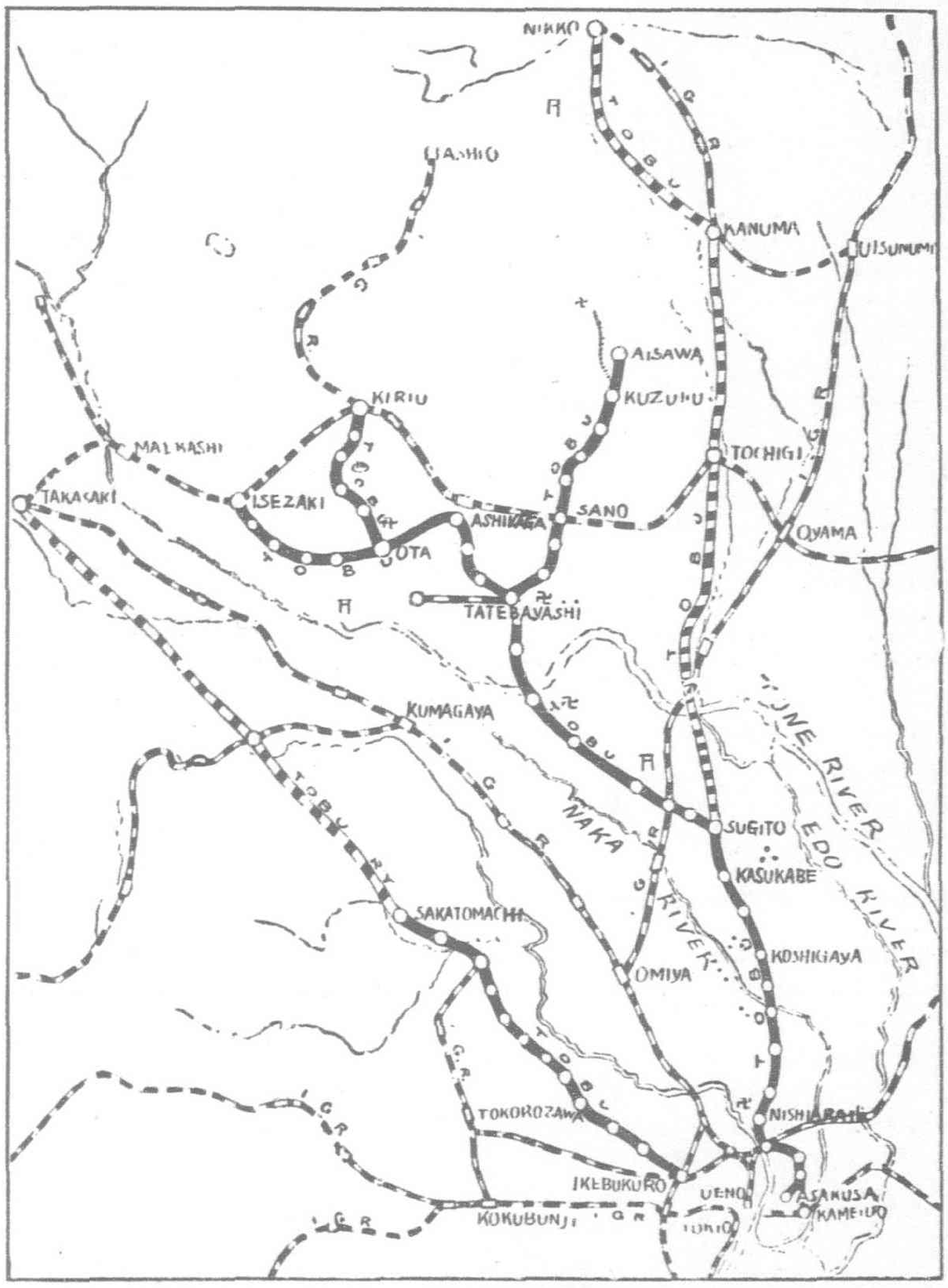
Tado Transformer Station

Equipment same as in Nishi Ogaki plant, except 20 K.V.A., single phase; 3 units, for power and light.

The power for the electric railway is transmitted from the transformer stations to Nishio station, the main line of transmission from that station to Tado being 20½ miles long, non-insulated, copper wire, B.S. 12, seven strands, to carry at maximum pressure 11,000 volts, A.C., 3 phase current. The poles carrying the wires are steel, cypress and cedar.

The railway line itself is served by overhead lines, hung on poles at both sides of the tracks (except in the stations), made of non-insulated copper, B.S. 40, for a maximum pressure of 1,500 volts, D.C., 2 phase.

The electric passenger cars are described as follows: 4 wheel bogie type, of which the company owns 8; weight: 27.78 tons; passengers: seated, 44, standing, 30; truck, 27 M.C.B., wheel diameter 33-in.; brakes: air, and hand; motors, direct wound: 50 h.p., 750 volts, 2 motors; D.C. connected, 1,500 volts; 4 motors in each car; gears, 65/79; brake: special multiple, P.C. No. 2; pantograph: made by: body, Nihon Sharyo K.K.; truck: Brill; air brake and controller: G.E.; Electric locomotives are now being designed.



Map showing the lines of the Tobu Railway Company. This Company controls more than 140 miles of railway in the Tokyo District, of which, it is reported, 89 miles are to be electrified

The Tobu Program

This is one of the most important electrification programs projected in Japan. It is reported that the Tobu Railway Co., the longest and most important of the private steam railways in the country, has just completed a contract for the electrification of its entire line, some 89 miles in all. Details are not yet available. The importance of this line in serving Tokyo can be seen from the map.

Including the lines licensed for construction but not yet included in the company's plans for new work, this company controls more than 140 miles of railway in and around the Kwanto district, the vicinity of Tokyo. The population of this district is on the increase at a greater rate than in any other part of Japan, and the increasing value of the silk business, the principal industry in the region the Tobu railway serves, is yearly making the company's profits greater and greater. This company, though, puts a large part of its profit each year back into improved equipment, and extending its lines. The line from Sugito to Nikko, through Tochigi and Kanuma is said to be the next licensed line which will be constructed.

Electric Railways in Osaka Suburbs

During the war, applications for licenses to construct electric railways amounted to more than 60. About fifteen of these have since been cancelled, either because they failed to begin construction within the fixed period, or because of changes in the projects which necessitated changes in the license.

The lines licensed to construct in the vicinity of Osaka are itemized below. Some of them have commenced construction, but for the greater part work has not yet been started, because of difficulties in raising the funds needed in the present state of the money market.

Name of Company	Termini	Mileage	Capital
Minami Osaka Dentstsu	Sakai City—Yamato Takata Machi	18.1	Y.2,500,000
Kita Osaka Dentetsu	Nishinari Gun, Nakashima machi—Kita Ku, Nishinoda, Sumida Machi	1.2	1,700,000
Konan Dentetsu	Osaka City—Sakai City ...	10.	5,000,000
Hanwa Dentetsu	Tosei Gun, Tanabe Cho-Wakayama City	36.7	Y.2,000,000
Hantan Denki	Nishinari Gun, Nakatsu Machi—Kyoto City, Kameoka Machi	28.	8,000,000
Sangu Dentetsu	Tosei Gun, Daioji Mura—Yamada City, Miye Prefecture	91.44	2,800,000
Tamatsukuri Denki	Shinstzu Mura, Osaka—Tennoji, 3.52 miles, Tsuruhashi Machi	4.2	3,600,000
Izumi Denki	Senpoku Hamadera Machi—Sennan Sano Machi ...	11.42	11,000,000
Ikoma Denki	KitaIkomaMura—KitaKochi, Maikata Machi	9.36	2,000,000
Osaka Denki	Kochi Gun, Fuse Mura—Yamato Yagi Machi	20.	3,000,000
”	4 chome, Tenma Bachi—Nakakichi Koshaei Mura ...	9.18	3,500,000
Nankai Tetsudo	Bokutei Mura, Tosei Gun, Imamiya Station of Kansai Government Railways Line	3.5	3,600,000
Osaka Tetsudo	Kashiwabara — Tamatsukuri Kashiwabara — Hyotanayama, Kori Mura ...	21.8	2,600,000
Kita Osaka Dentetsu	Toyosaki Machi, Nishinari Gun, 4 chome, Tenjinbashi Suji	4	1,300,000
Hanshin Kyuko	Shikitsu Machi, Kitsu, Adachi Machi, Tosei Gun	4	3,000,000
Izumi Denki	Hamadera Machi, Imamiya Machi, Tosei Gun	8.4	10,000,000
Kitsugawa Tetsudo	Shikitsumachi, Tosei Gun, Fukida Machi, Mishima Gun	16.2	8,000,000
Shin Osaka Dentetsu	Hieshima Mura, Nishinari Gun, Kamitsumura, Nishinari Gun	10.64	8,000,000
Myoken Dentetsu	Yoshikawa, Hono Gun, Togo Mura, Anamushi Gun ...	3.32	5,000,000
Ikoma Cable Car Line	Otomura, Nakakochi, Summit of Ikoma Mountain ...	1.68	400,000

The Yagi line of the Osaka Denki, and the lines of the four new companies, Konan Dentetsu, Tzumi Denki, Ikoma Cable Car Line, and the Arrima Denki, not listed above, have all recently received their licenses.

Municipal Transportation in Osaka and Tokyo

The most important details in the plans for the enlargement of the boundaries of the cities of Tokyo and Osaka, are those for the extension of the existing transportation systems. These organs of communication today are so incomplete that they are almost the laughing stock of the world. Unless extended, it is impossible to carry out the ambitious schemes for city expansion and improvements.

Viscount Goto, who recently resigned as mayor of Tokyo, devised plans for a Greater Tokyo, and presented them before the last session of the diet where they failed to receive approval. It was believed in the diet that the plans were quite desirable, but it was also considered that the most urgent duty of the Tokyo municipality is the immediate construction of an adequate transportation system within its present boundaries.

It was planned in 1910 that the licensed routes owned by the municipality should be constructed with an appropriation of Y.130,000,000. These lines have been gradually opened, but the expansion of Tokyo has been so great that the old transportation plan could not cope with the ever growing needs of the population. The outstanding feature of the transportation system in Tokyo is the glaring fact that there is no parallel at all between the growth of the city and its suburbs, and the transportation lines.

The city of Tokyo depends for its supply of power upon the three private concerns, the Kinugawa Hydro-Electric Co., the Katsuragawa Hydro-Electric Power Co., and the Inawashiro Water Power Co., and when accidents occur, transportation stops. Such accidents are frequent, and it is becoming more and more difficult to move the city's surface cars with ease. There are about 180 miles of surface lines in Tokyo to-day, and not more than 1,400 cars in continuous operation. The population of the city is estimated at two and a half millions. The lines being incomplete, according to the location, traffic is always confused. The local papers invariably declare that one is taking one's life in one's hands both morning and night in trying to get to business and home again on a Tokyo city surface tram; and this is hardly an overstatement of the facts.

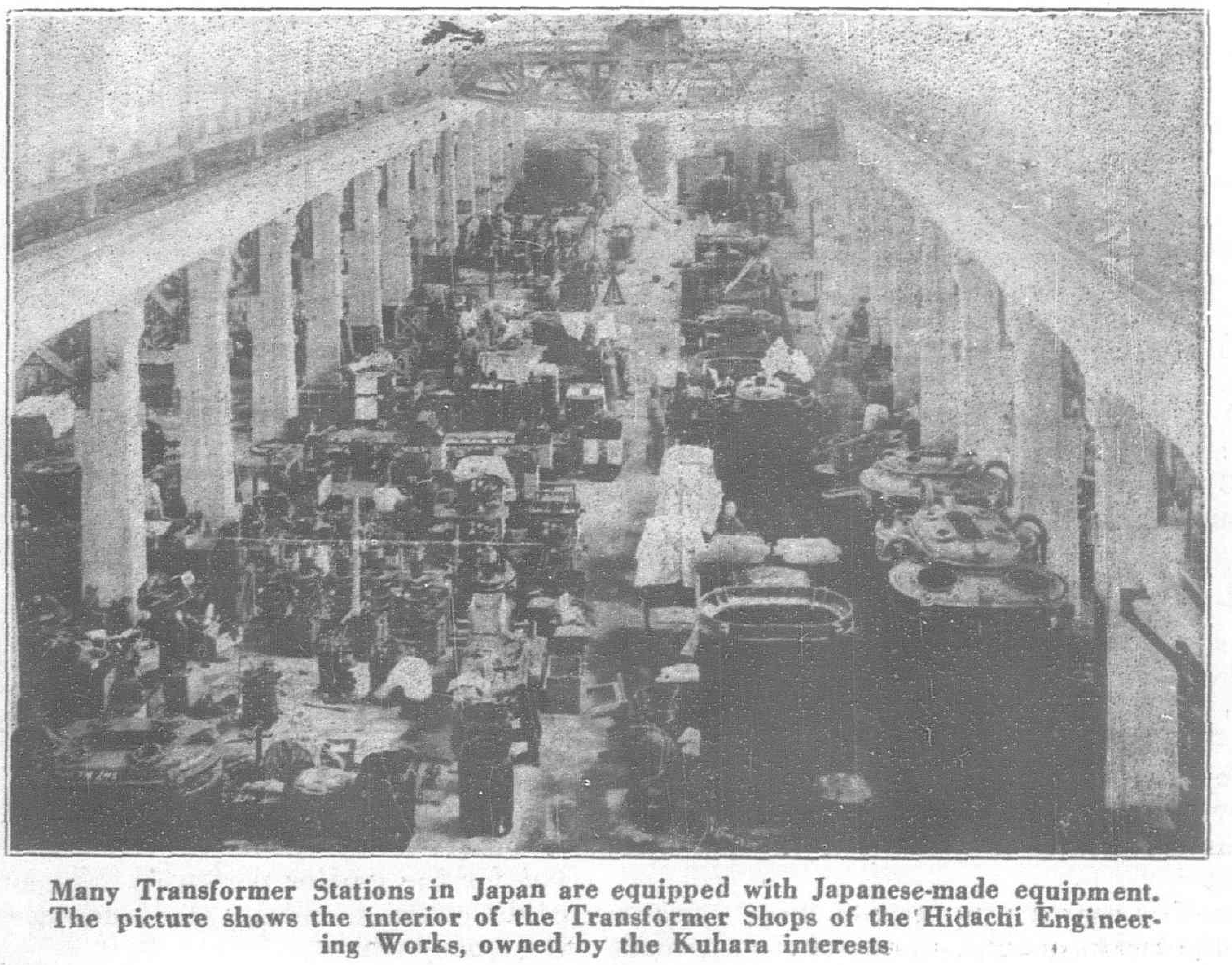
The only auxiliary transportation system in Tokyo city is the city and Suburban Motor Bus Company's motor bus service along certain of the main streets of the city. It is reported that this company is meeting with financial difficulties, and it is a fact that the service is entirely too expensive. The business results have been so poor that it has been impossible to expand its system in accordance with the city's needs.

There are many plans for improving Tokyo's unbearable transportation system, but after all, these are only plans, and the public keeps asking, when will they begin construction?

The chief of the Tokyo electric bureau, Nagao Hampei, has recently advanced another plan to meet the existing emergency, created largely by the building up of a great business centre in the heart of Tokyo called the Marunouchi district. His idea is to construct a double track subway line one mile long between Toranomon and Hitotsubashi, passing through the Marunouchi district.

The present tram lines leading into Marunouchi cannot begin to handle the rush hour traffic, and it is to help out at this time, that this subway is planned. This line would pass from Toranomon by Tokyo station, and to Ota Machi, coming out at the entrance to the Imperial Commercial University at Nishiki Cho, in Kanda. The cost of construction for each mile of single track is estimated at Y.3,500,000, a total of Y.7,000,000 in all. The plan has been approved by the city assembly. The plans and survey will be drawn up next year! This does not seem to be rushing to meet the emergency.

Certain attempts have been made to decrease the congestion along main lines of traffic by operating express service cars. A trial made some three months ago, between Shinjuku and Hibiya Park was rather disconcerting in its results. It was found that the running time was more often than not, longer than that of the ordinary services. It is said that the city municipal tramway authorities learned more about the absurdly congested state of the surface system from

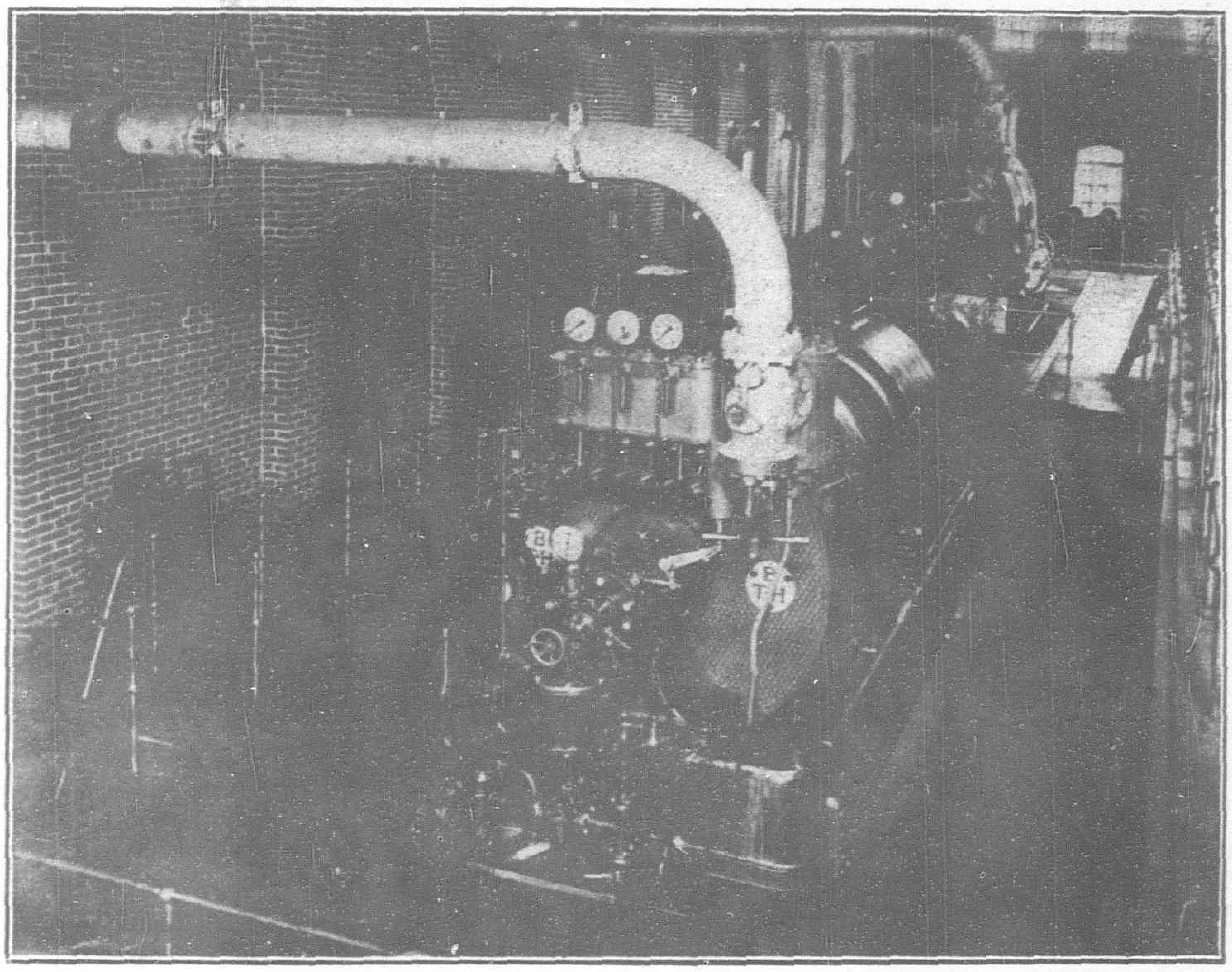


Many Transformer Stations in Japan are equipped with Japanese-made equipment. The picture shows the interior of the Transformer Shops of the Hidachi Engineering Works, owned by the Kuhara interests these tests than from all the complaints made against the service during the past five years.

The subway plan does not cover much ground. It only relieves (if it will relieve) and it is to be doubted if it can ever do that especially as by the time it is built the emergency will be infinitely more acute than it is now, the traffic in Marunouchi, and Kanda, where at the early morning hours, and around 5 o'clock in the evening there is an ever growing traffic of business men and students. As a matter of fact the plan is generally derided by the more careful students of Tokyo's transportation problems.

The Osaka Plan

Osaka is also growing beyond its present surface tramway facilities. The Osaka municipal assembly has been considering a plan for the construction of a high speed railway system in the city limits at a cost of Y.130,000,000. Construction, when started, is to be completed in five years.



Two B. T. H. Turbo-Generating Sets installed by the General Electric Company in the Sumiyoshi Power Station of the Kyushu Electric Light and Traction Company at Hakata

The plan includes: From Umeda station (The Osaka Railway Station on the Tokaido Line) one line will be built to the west, passing along the west bank of the Yokohori Gawa, passing through Shinanobashi and Yotsubashi, reaching Minato Machi station. It will then turn to the south and reach the station of the Nankai Tetsudo Co., and from there proceed to Tennoji Park.

The second line will start from Umeda station and turn to the east, obliquely to Kitano Machi underground, coming out at Sugawara Machi, Nakanoshima, passing through Higashi Bashi, along the east bank of the Yokohori Gawa. At Sueyoshi Bu, it will turn to the south-east, and at Kawaraya Machi, Teraka Koya Shita, it will go underground again, and straight ahead to Kami Honmachi 6 chome, to the end of the line of the Osaka Kido company. From this point it will curve away to the south-west on to Tenoji Park where it will connect with the line from the west. From the connecting point the east line will again pass to the line of the Hankai Densha, connecting with it between Kasumi Cho, and Imamiya stopping points. From this point a branch will be built to the Osaka Kido line at Kami Honmachi. The line will come to the surface at Nihonbashi Suji, one to the south of Sen Michi Mae, will connect with the west line. A branch will also be built from Yotsu Bashi which will pass from Nishi Nagahori Gawa through Matsusima, reaching Kujo, where it will connect with the suburban surface tram lines.

The total distance of these main lines and their branches is 33 miles. Compared with the Tokyo plan this is an ambitious scheme, and as it is planned to reach the stations now scattered in all outlying districts about the city, it will be of immense benefit in bringing the people into and out of the main districts of the city. Part of the line will be underground, part elevated, and part surface. The details are not yet available. The assembly has not yet passed the scheme.

If this line is approved and constructed, it will undoubtedly favorably affect the transportation situation in Tokyo. The capital can hardly permit itself to be placed in the second position in such an important matter of civic improvement.

It is reported that the private railway lines leading out of Osaka in all directions, are planning a central station for all their lines, to be built in the heart of Osaka city. If this is accomplished it will undoubtedly make Osaka the best served city in Japan.

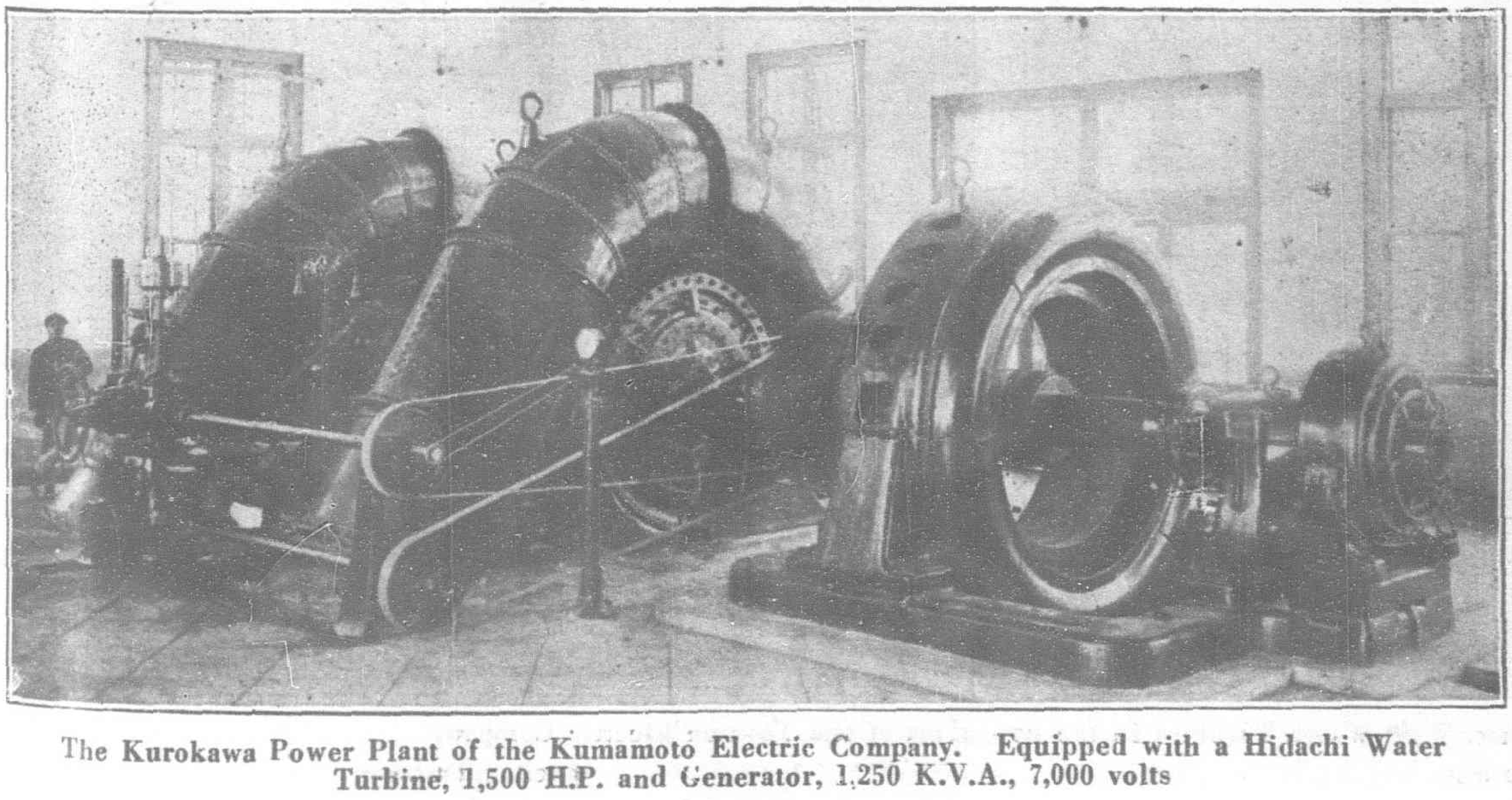
Although several reports have been published recently to the effect that the Tokyo Underground Railway Co. has been able to raise the funds needed for its construction plans for building a subway in Tokyo, they are not officially confirmed. Negotiations are under way with an important American engineering construction firm, but they are entirely dependent on the reports of their engineers, now in Tokyo.

Tokaido Line Electrification

The department of railways is very busily perfecting its arrangements for the electrification of the Tokaido line, especially on the sections between Odawara and Tokyo, and Ofuna and Yokusuka.

Recently two electric locomotives purchased from Westinghouse were tried out with satisfying results. Two from the General Electric were also tested satisfactorily. Two locomotives from Brown Boveri and others from the English Electric will soon arrive for trial.

Japanese manufacturers, the Hidachi Enigneering Co., the Shibaura Engineering Works, and the Toyo Electric Mfg. Machinery Co. have received orders for the genera-



The Kurokawa Power Plant of the Kumamoto Electric Company. Equipped with a Hidachi Water Turbine, 1,500 H.P. and Generator, 1,250 K.V.A., 7,000 volts tors, and transformers needed in the stations to supply this line. These orders are nearing completion. It is believed that the government railway car building shops at Omiya, near Tokyo, will soon be able to build all the cars needed for these electrified lines, and that within two or three years Japan will be in a position to supply all the equipment needed in its newly electrified railways.

The transformer stations which will be erected along the new Tokaido line are listed below:—

Kawasaki Transformer Station.—Rotary Converters: 2 units, 3 sets, 2,000 kilowatts. Transformers: 3 units, 2,100 K.V.A., ordered from the English Electric Co.

Kawasaki Juden Transformer Station.—Transformers: 9 units, 3,000 K.V.A., ordered from Shibaura Engineering Works.

Kawasaki Transformer Station.—Rotary Converters: 2 units, 2 sets, 1,000 kilowatts. Transformers: 2 units, 2,100 K,V.A., ordered from Westinghouse. (Takata & Co., Agents.)

Ofuna Transformer Station.—Motor converters: 3 units, 2,000 kilowatts. Bruce Peebles (Healing & Co., Agents). Transformers: 3 units, 2,100 K.V.A., orderedfrom Mitsubishi Denki K.K.

Ninomiya Transformer Station.—Motor Converters: 2 units, 2,000 kilowatts. Bruce Peebles (Healing & Co., Agents). Transformers: 2 units, 2,100 K.V.A., ordered from Mitsubishi Denki K.K.

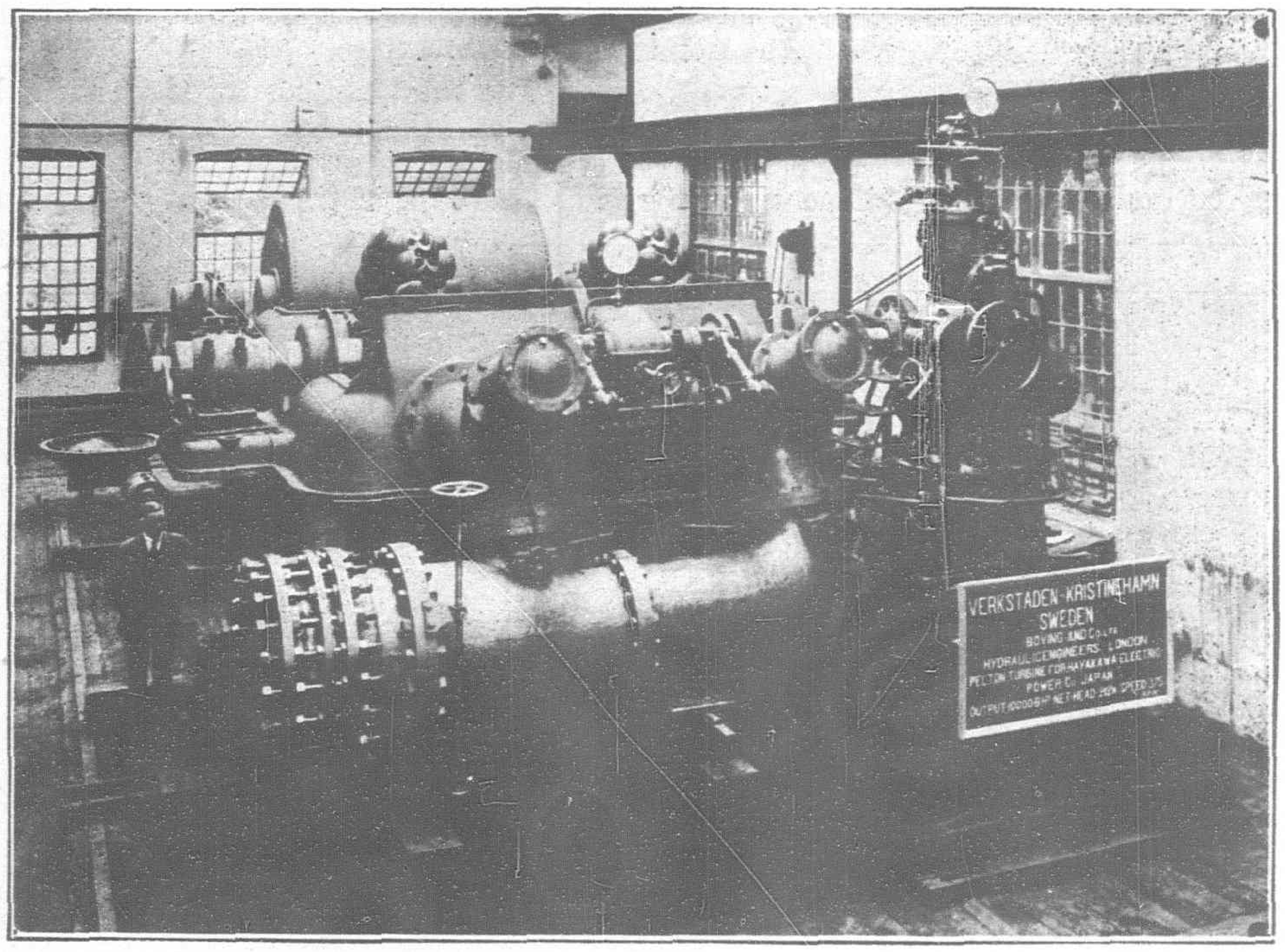
Akabana Juden Transformer Station.—Transformers: 6 units, 3,000 K.V.A., ordered from Hidachi Engineering Works.

Electric car motors of 150 h.p. each have been ordered from:

Hidachi Engineering Works, 100; Toyo Denki Seizo K.K., 100; Shibaura Engineering Works, 20.

Controllers have been ordered from:

Hidachi Engineering Works, 100; Shibaura Engineering Works, 50.


VERKSTADEN-KRISTINEHAMN
SWEDEN
BOVING AND Co. Ltd
HYDRAULIC ENGINEERS LONDON
PELTON TURBINE FOR HAYAKAWA ELECTRIC
POWER Co. JAPAN

The Hayakawa Electric Power Company, of Tokyo, recently purchased from Boving & Co. four 10,000 H.P. Petton Turbines, 375 r.p.m., under a head of 700 feet, for installation at its new power plant on the Hayakawa River, a tributary of the Fujikawa, in the Tokyo supply district. The turbines to be delivered this summer, will be directly connected to Shibaura Engineering Works' Generators of 7,000 k.w.

Pantographs have been ordered from:

Hidachi Engineering Works; Shibaura Engineering Works and Toyo Denki Seizo K.K.

All these companies are working almost at capacity to supply these orders.

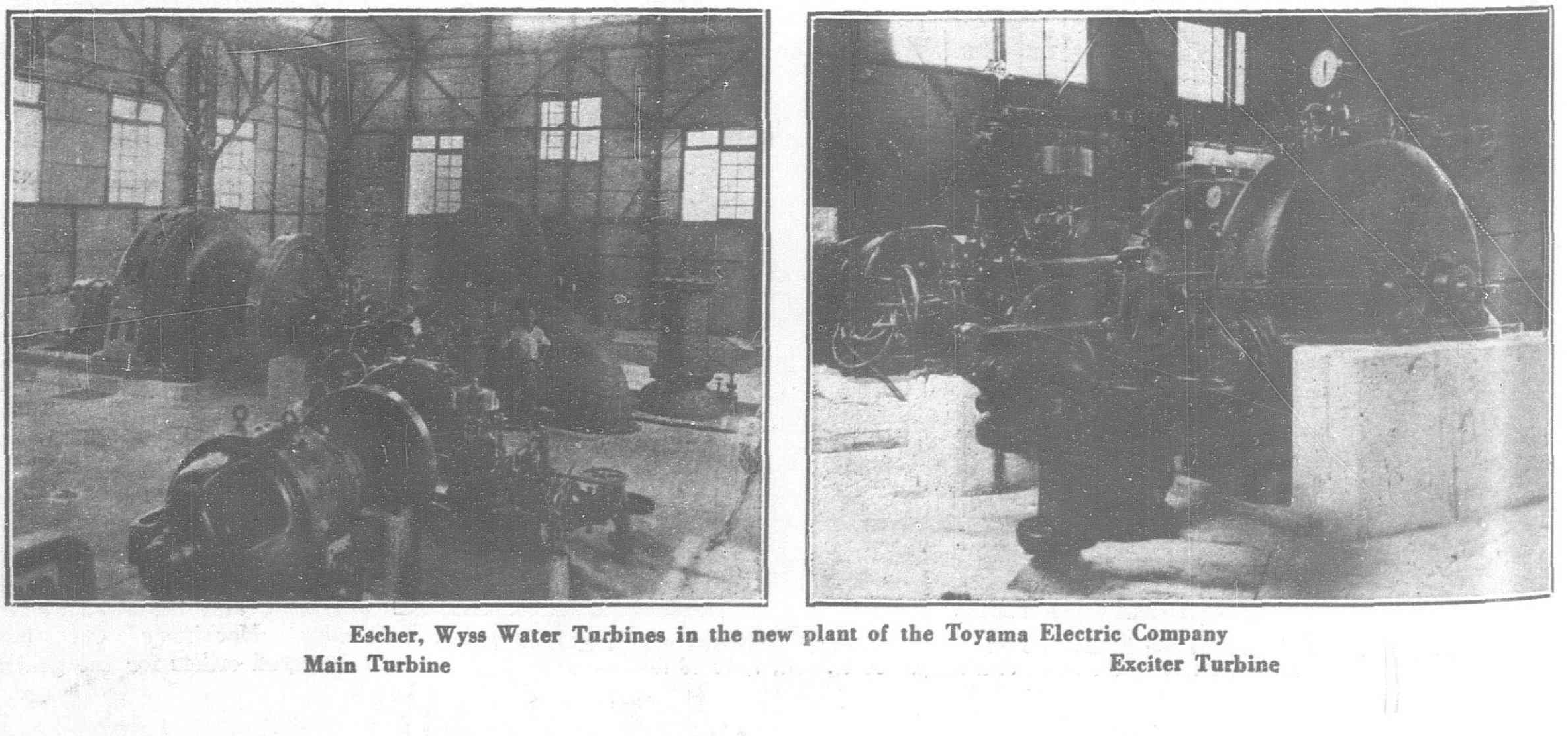
Power Supply

The government is building the Shinano River power plant to supply the power needed by this electrification. This plant is far from completed, and at present the only plant the government owns which can supply power to the Tokaido line is the Akabane steam plant, in the suburbs of Tokyo, generating 10,000 kilowatts.

In the beginning, power will be purchased from private companies. The department of railways will make a leisurely survey of the power needs of this line and consider ways and means of providing the necessary power later on. There is much discussion going on in the railway department at present concerning the purchase of more equipment. One party is anxious to purchase many more locomotives abroad this year, while the other urges consideration of the locomotives which have arrived and are arriving before others are imported. It is believed that the conservative element will have its way, much to the disappointment of many electric machinery manufacturers.

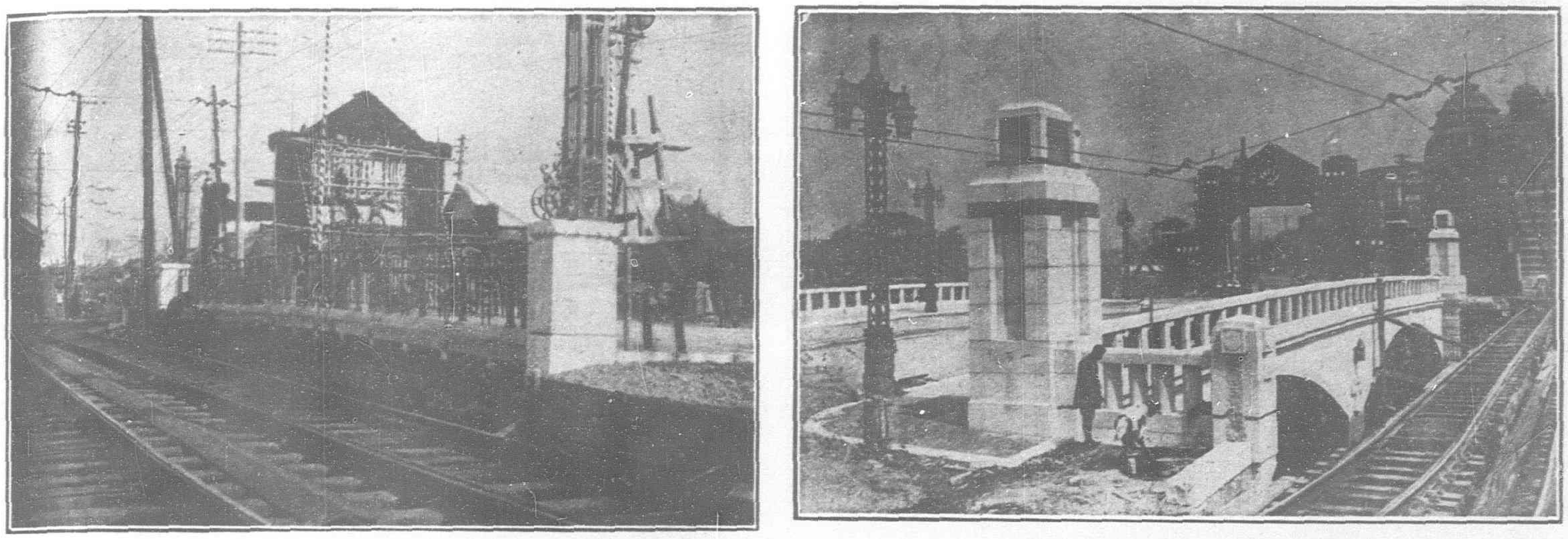
Plans to Electrify Japanese Steam Railways

The outstanding feature in the transportation situation in Japan to-day is the extensive electrification of private railways which is rapidly being carried out. The Musashino railway electrification has attracted such favorable notice that other lines have turned their attention to electrification, with the result that it is



Escher, Wyss Water Turbines in the new plant of the Toyama Electric Company

Main Turbine **Exciter Turbine**



Types of New Bridges over the canals of Tokyo, made necessary for carrying the heavy tramway traffic

just now reported in Tokyo that the Tobu Railway Co. will electrify its entire line. This railway is Japan's most important private railway line, and its example is sure to have a most decided effect on the future electrification of other lines.

The Satobe railway originally constructed to transport the materials for erecting the Toyo Aluminium Co. plant has just been electrified for general freight and passenger service.

The Chikuma railway constructed in 1921 to carry the materials for building the power plant of the Keihin Electric Power Co., to-day it is the only country railway line using bogie type cars.

The Yamanote electric line, owned by the government, running around the city of Tokyo from Tokyo station to Uyeno station, passing through all important suburbs, now carries 50 per cent. more passengers than it was originally planned for. It is utterly unable to handle the traffic.

All private railways in Nagano prefecture have recently turned their attention to electrification. One-tenth of them own their own power, and estimate that they can consume it all on their railway lines. Fifty miles of railways have been built in this prefecture, and there are 80 miles licensed not yet built. Besides these there are another 80 miles of licensed steam railways not yet constructed. More than 60 miles of these steam lines will be built for electric operation, and new licenses are now being requested to cover the changes.

The Jotoku railway originally built as a connecting link between the Joban and Tohoku lines of the Imperial Government Railways, a distance of 32 miles, with a 3-ft. 6-in. gauge, will soon be electrified, with a 4-ft. 8½-in. gauge.

The electric bureau of the railway department is now investigating applications for electrification from the

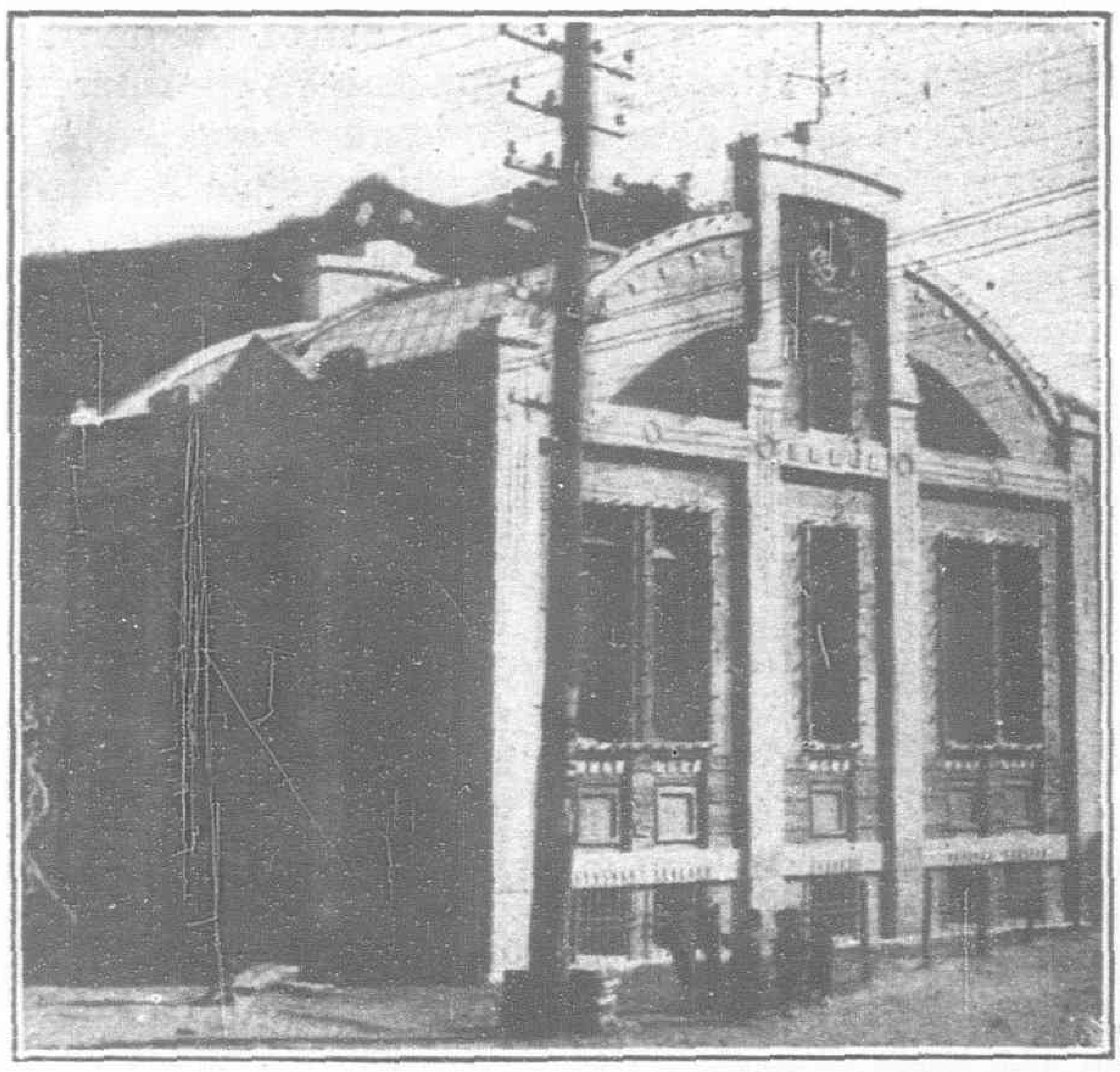
Yabakei Railway Co., an excursion line, with a 2-ft. 6-in. gauge.
Nansatsu Railway Co., passenger and freight line, 3-ft. 6-in. gauge.
Nishio Railway Co., passenger and freight line, 3-ft. 6-in. gauge.
Kokura Railway Co., passenger and freight line, 3-ft. 6-in. gauge.

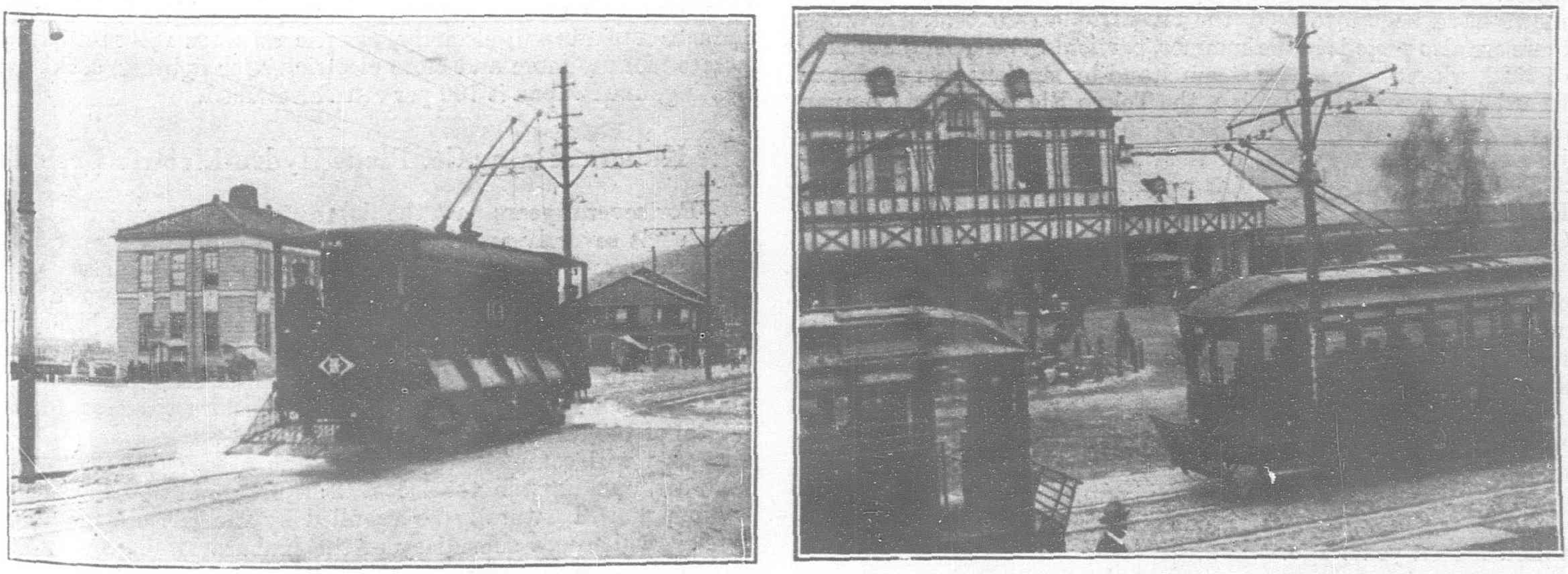
Information on these companies follows:

Yabakei: capitalized at Y.625,000, has 15.4 miles of line in operation, constructed at a cost of Y.52,500 a mile. It owns five water tanks, and uses a 28.3 pound rail. Operates 15 passenger cars, and 41 freight cars.

Nishio: capitalized at Y.600,000, has 16.4 miles of line in operation, constructed at a cost of Y.35,500 a mile. It owns four water tanks, and used a 20-pound rail. It owns 13 passenger cars.

Kokura: capitalized at Y.4,520,000, has 24.9 miles of line in operation, construction costs not known publicly.



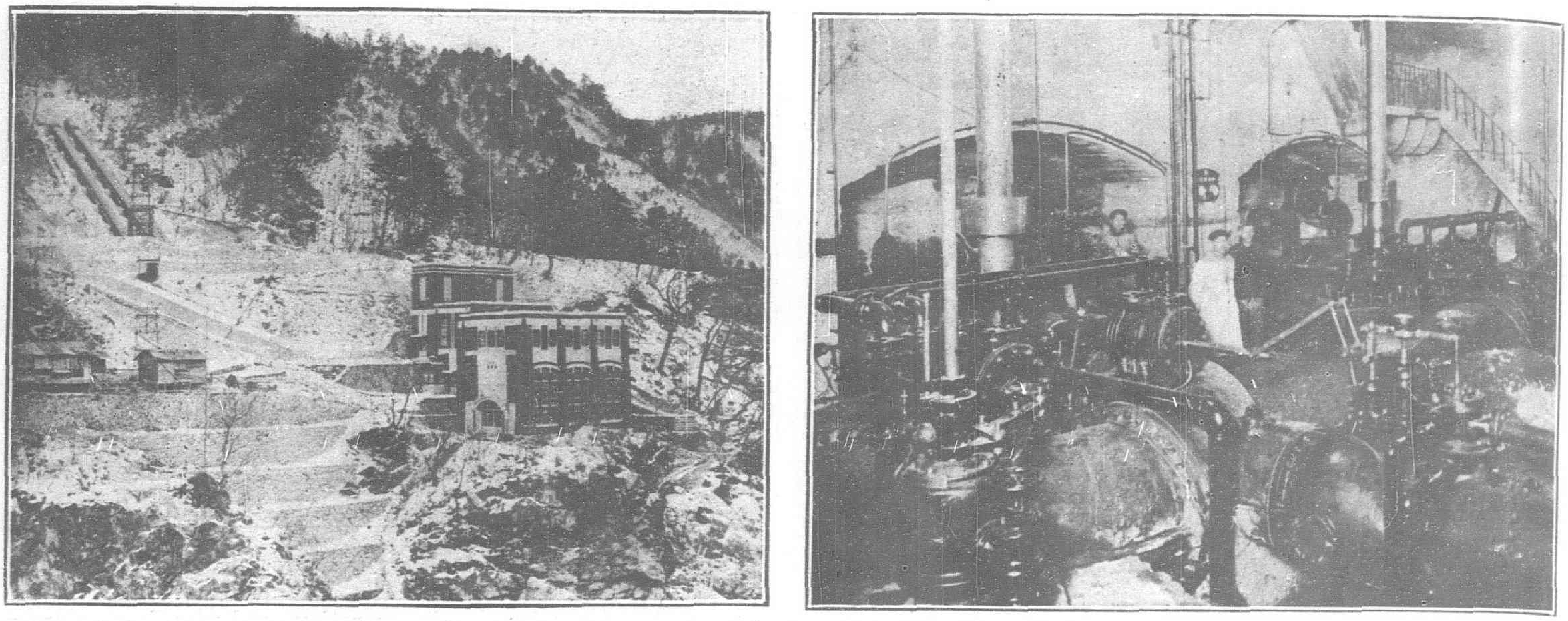


The Nagasaki Electric Tramway receives its power from the Kyusho Electric Railway Co.

Top—Transformer Station

Water Tank Car

Station of the Imperial Japanese Railways showing Tramway connection



One of the Kinugawa Water Power Company's plants equipped with a 5,700 H.P. Water Turbine, 500 r.p.m. at 275-ft. head, made at the Kameido Shops of the Hidachi Engineering Works

It owns ten water tanks, uses a 60-pound rail, and owns 16 passenger cars, and 230 freight cars.

Nansatsu : capitalized at Y.1,000,000, has 19.6 miles of line in operation, construction costs not publicly known. It uses a 45-pound rail. Other details not published.

All these lines will be electrified by 1926. The Nishio and Yabakei will require about Y.18,000 to Y.19,000 a mile for electric equipment, and the Kokura from Y.23,000 to Y.24,000. Rails now 20 pounds, with a 2-ft. 6-in. gauge must be changed to 60 pounds with a 3-ft. 6-in. gauge. But the Yabakei with its 28-pound rails and 2-ft. 6-in. gauge can use a 9-ton electric locomotive without making any great changes. The Nishio will change to a 3-ft. 6-in. gauge, and use a 15-ton locomotive.

The only one of these lines which will own its power supply is the Kokura Railway Co., which will construct a hydro-electric plant in North Kyushu to supply its needs. The others will purchase power from the Kyushu Water Power Co.

Hydro-Electric Companies Place Large Contracts for Steam Plants

The recent large expansion in water power plants in Japan has greatly stimulated the use of electric light and power for industries and railways. At the same time, it has necessitated the installation of large steam turbines located near the centres of distribution, which must carry the load during periods of low water. This emergency usually occurs in the winter before the snows have begun to feed the rivers to any extent. However, there are also periods in the summer, particularly during the summer of 1922, when the need for steam stand-by stations was evidenced. In order to meet this situation, the Tokyo Electric Light Company has projected a 100,000 K.W. (150,000 H.P.) steam plant, and has just ordered the first half of their equipment, consisting of two 25,000 K.W. fifty cycle turbine generators from the Westinghouse Electric International Company, through their agents, Takata & Co.

This equipment, with necessary switch gear condensers, boiler plant and buildings represents an investment of Y.8,000,000. The machines are the largest ever supplied to Japan and operate at a speed of 1,500 turns per minute. Each unit weighs 300 tons, which, accordingly, must be dismantled for shipment, and rebuilt by experts at the site in Tokyo. Some idea of the size of these units can be obtained from the fact that one ton of coal per minute is required to operate the two machines at full load. These turbines are of the well-known Westinghouse impulse-reaction type, and are of the same general design as machines now in use which were installed fifteen years ago.

Another important order has been placed with the Westinghouse Company by the Toho Electric Power Company, for their Najima power station near the twin cities of Hakata and Fukuoka in the island of Kyushu. This installation consists of one unit of 20,000 kilowatts, operating at 1,800 r.p.m., as it must supply 60 cycle current. The site chosen for the plant is ideal, as it is located on a river within easy distance of numerous coal mines. Furthermore, it is practically at the centre of distribution for electric power and light in the island of Kyushu.

One of the most important uses of this machine will be to guarantee a continuous power supply to the Kyushu electric railway company which is developing interurban lines to insure easy and rapid transportation between the cities of this district.

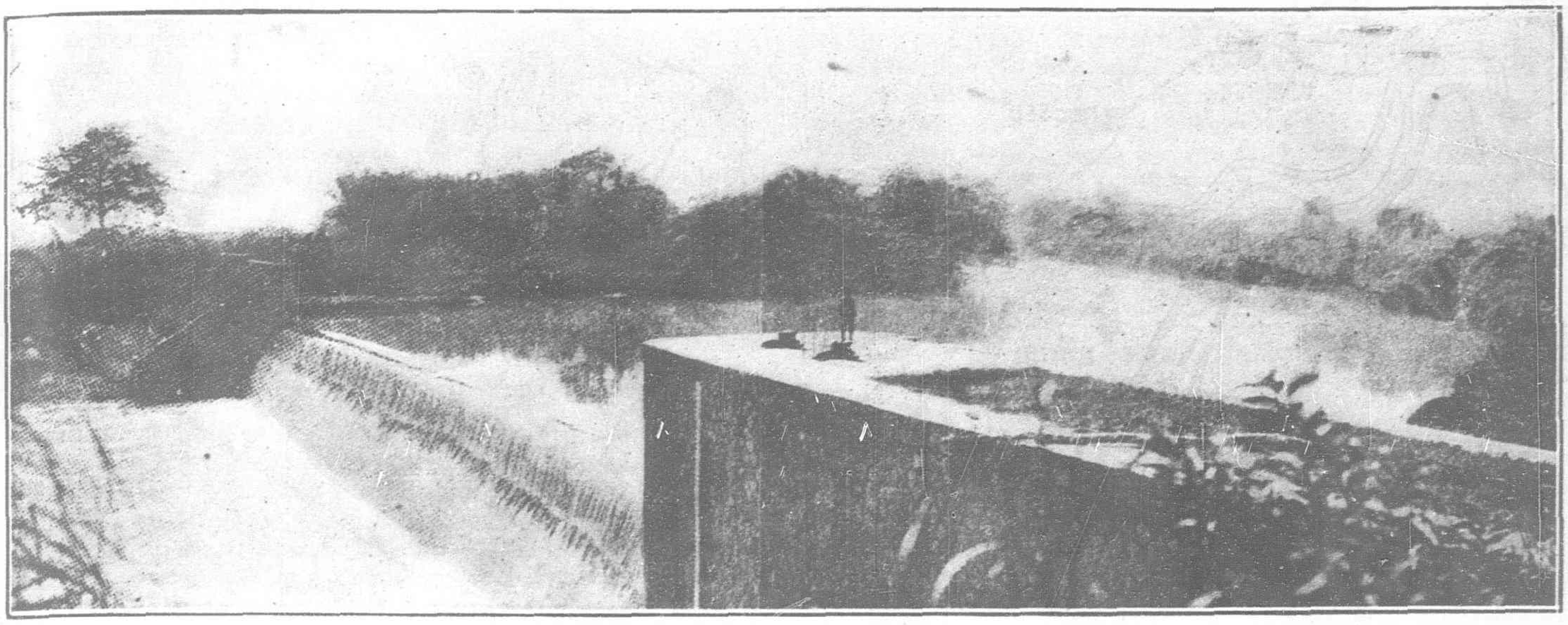
The reason for the selection of these 40,000 h.p. turbine generators was the fact that this make had been thoroughly tried out in Japan with the most gratifying results. As long ago as 1917, Westinghouse 25,000 kilowatt turbines were ordered by the Osaka Electric Light Company for installation at their Kasugade No. 2 power station. These have been operating for some time, supplying a large part of the light used by the city of Osaka, and a continuous run of two months without inspection is of common occurrence. In the future, such exacting demands will not be made, as these machines will be linked up with the super-power hydro-electric system of the Daido Electric Power Company, which has now invaded Osaka.

These stand-by steam turbine plants in Tokyo, Osaka and Kyushu will serve as a guarantee of electric light and power to over 5,000,000 people. The use of electricity will be greatly stimulated by these safeguards, and there will no longer be any hesitation towards making use of the conveniences offered by electricity. All industrial plants will electrify, electric railways will multiply, and homes will use more and more electricity for lighting, cooking and heating, until Japan is 100 per cent. electrified.

The Kuhara Mining Co. Plans Hydro-Electric Enterprise

For several years past the depression of the copper market in Japan has severely restricted the operations of all copper mining companies, and among them the Kuhara Mining Co. has also been obliged to suspend several of its plans. Recent improvement in the price of copper abroad has had a very favorable effect on the Japanese copper companies and the Kuhara Mining Co. is now said to be preparing to begin construction of hydro-electric plants planned many years ago, on the Sho, Shira and Koshira Rivers, to develop a total of 100,000 k.w. It is estimated that the first period of construction will complete 60,000 k.w., at a cost of Y.600,000 per kilowatt, making the total cost Y.24,000,000. All the machine equipment will naturally be supplied by the Hitachi Engineering Works, which is a subsidiary of the Kuhara Mining Company.

It is expected that work will be begun this year, and that a call for payment of unpaid balance of capital on the new share issues of the Kuhara Mining Company will soon be made.



Irrigation at Kep—Can-son Dam

Irrigation in Indo-China

ALTHOUGH in recent years the cultivation of certain new plants, such as hevea, cotton, sugar-cane, etc., has been introduced into Indo-China, that of rice remains far and away the most important, and this plant requires a large amount of irrigation per acre. For this reason irrigation is of capital importance in a country where the rains and consequently the volume of the rivers are very irregular. The problems to be solved are three-fold: ordinary irrigation by gravitation, controlling rivers and their floods (the Red River and the Me-kong) and regulating the effects of the tide in the canals of Cochin-China.

1. Tonkin

In Tonkin it is a question of irrigating the land and also of protecting them from the floods of the Red River. While it is true that some of the irrigation canals may be utilized for navigation, yet this use remains strictly subordinate to that of irrigation.

Although Tonkin is very densely populated yet it is manifest that the natives do not draw all the riches they might out of the soil, the principal reason for which is the irregular natural irrigation. The water arrives either too soon and is afterwards insufficient for the proper growth of rice or other crops, or too late to allow of the sowing, or, owing to copious rains or to the river bursting its banks, the whole country is flooded and the crops are totally lost.

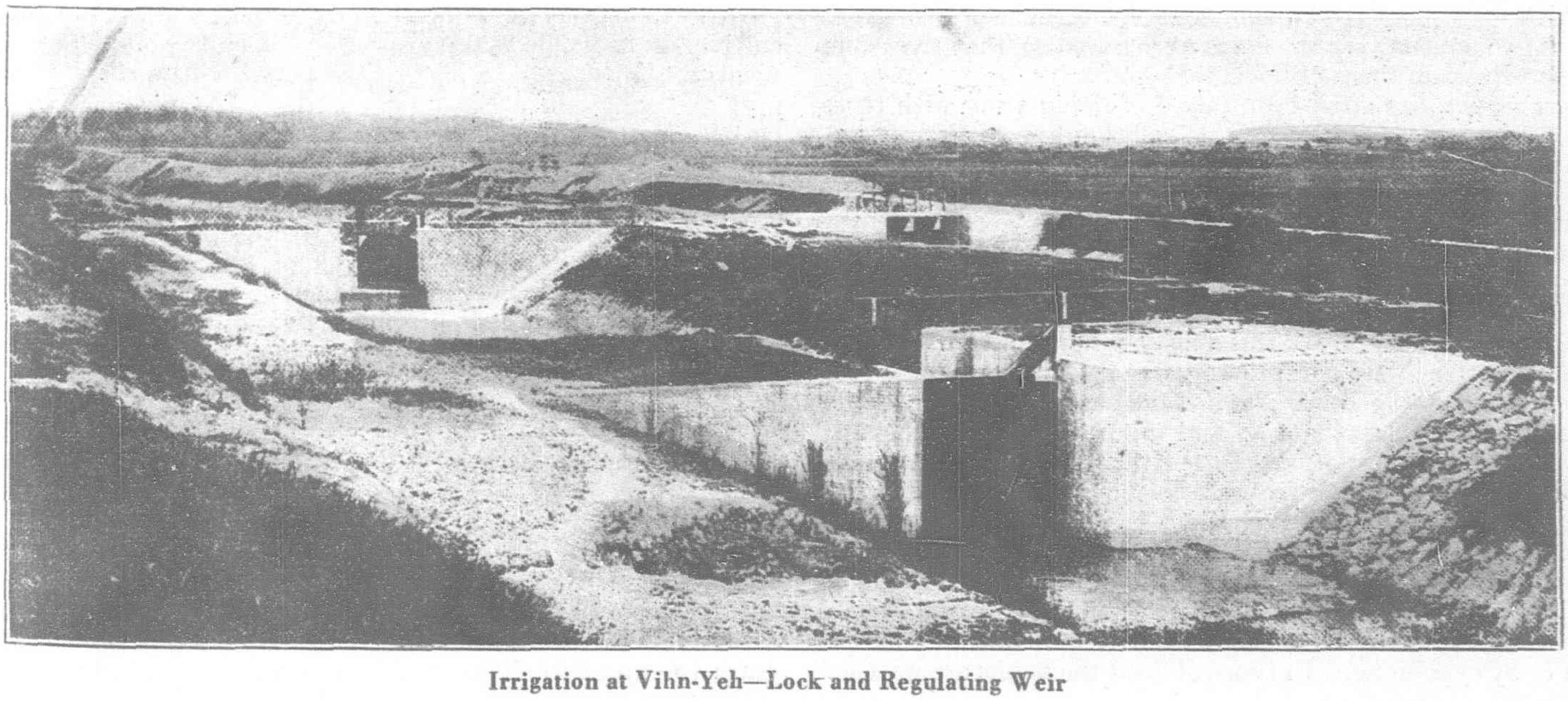
(A) Works Against Floods

In Tonkin the delta of the Red River is the most fertile and the most densely populated part, so that the works controlling this river are of the highest importance.

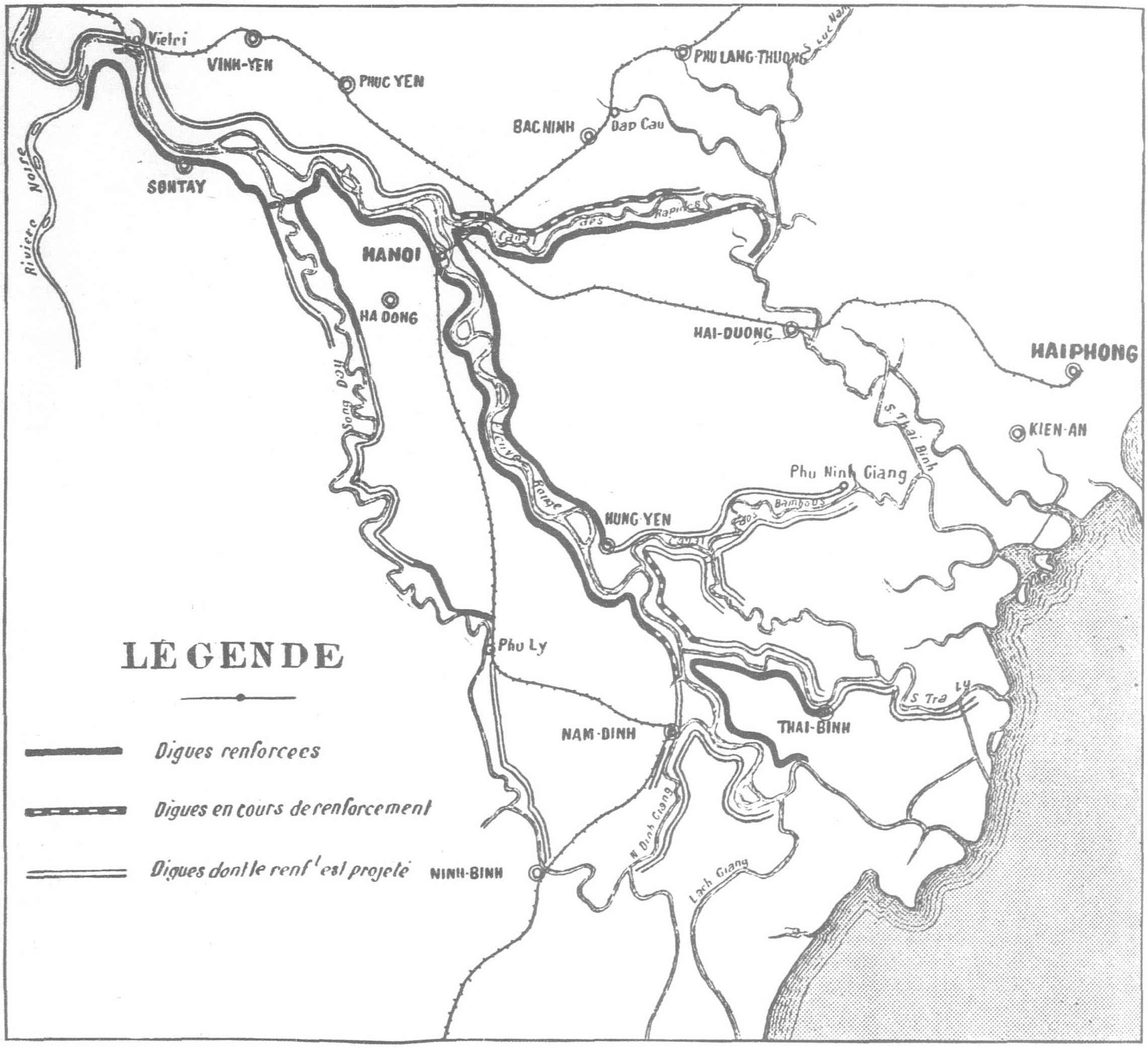
Both the Red River itself and the mouths through which it reaches the sea are protected by dams, so that in flood times the level of the water is considerably higher than the surrounding country. In 1917 the Red River at Hanoi reached the height of 38-ft. above sea-level, whereas the surrounding country is but 16½-ft., from which will be seen the extent of the danger menacing the delta during several months of each year.

The breaking of a dam always spells disaster, for not only are the crops destroyed but the mud huts of the natives are quickly swept away and they and their cattle are often drowned. Further, when the water breaks through it deposits an immense fan-shaped spit of sand reaching often far over the country and putting an end to all cultivation of the land thus covered.

The damming of the Red River began some 700 years ago, although an embankment to protect the town of Thanh-Long



Irrigation at Vihn-Yeh—Lock and Regulating Weir



River Embankments of Tonkin

(now Hanoi) existed prior to this. At first but low dams were built which were submerged during high floods, but with a view of obtaining two crops a year the dams were raised so, that they were never overtopped in times of flood.

The question has often been raised of doing away with these embankments, and at first sight this solution appears attractive, for it is contended by many people that the Red River would thus become a second Nile covering the rice-fields each year with its fertilizing mud, and as the annual floods would be spread all over the country, it would be about a foot deep at the most, while the fertility due to the mud would make up or the loss of one of the present annual crops.

After a thorough study of this question, during which the most enlightened natives were consulted, it was recognized in 1905 that the suppression of the dams was impossible, and that the only thing to do was to keep them up and to strengthen them against the erosive and bursting actions of the river. That this is no mean task will be realized when one bears in mind that the volume of water brought down by the Red River has been known to reach 30,000 cubic yards (6,600,000 gals.) per second, and that during the floods of 1917 some 52,000,000,000 cubic yards (8,800,000,000) gals.) of water poured through the breaches in the embankments.

These breaches may be caused either by infiltration or simple pressure or by syphoning. In times of flood the banks are watched day and night, and they and the land immediately behind them are always kept as far as possible free from buildings or from such cultivation as would make inspection difficult, while all near-lying ponds are filled up. In all this the native villagers take a willing part and maintain a constant guard on the neighboring dams. On the least sign of danger the villagers, who naturally realize that their all is at stake, are called and carry out the necessary strengthening works without delay.

A breach may also be caused by the flood overtopping the main dams owing to the little supplementary dams hurriedly raised in times of specially high flood not being strong or high enough to retain the water which, beginning by a thin overtopping stream, soon washes everything away.

Finally breaches may be due to the river changing its course as its erosive action at bends is very great.

All this goes to show the vital importance of these defence works, which have been thoroughly studied by each succeeding government engineer. The vagaries of the Red River are by now sufficiently known to enable application to be made of suitable remedies for the mitigation, as far as possible, of its inherent dangers, but in view of the enormous volumes of water that have to be dealt with, as well as to the suddenness of the floods, it would be too much to expect to eliminate all accidents. It is, however, hoped to reduce these to a minimum by strengthening the dams and improving the access to the sea.

In Tonkin some 1,250 miles of dams are to be found ; and their maintenance necessitates the consolidation of weak spots, the building of new dams and the raising of others above flood level, as well as the fixing of the bed of the river.

The consolidation of the dams has been undertaken since 1918 and has cost as follow :

1918	300,000	piastres
1919	360,000	—
1920	560,000	—
1921	540,000	—
Total	1,760,000	—

Every effort has been made to fix the bed of the river as far as possible. In 250 places rip-rap stonework has been built, costing in 1916 about 300,000 piastres, while since 1917 some 80,000 piastres have been devoted to this work every year.

At some important places the actual bank on the outside has been faced with stone and this has been notably the case at Son-tai and at Xam-Thi and Co-lieu in the province of Hadong ; the cost of this was as follows :

Son-tai	20,000	piastres
Xam-Thi	130,000	—
Co-lieu	100,000	—

All the works above enumerated have notably reduced the number of breaches, and further projects for the improvement of the months of the rivers are now being studied.

(B) Irrigation

Although exposed to floods in the rainy season the crops require irrigation in the dry.

Before the French occupation the natives had taken no serious steps towards irrigating their fields ; rudimentary sluices, it is true, had been established here and there but under unscientific conditions. These works furnished but poor results and simply met, in an extremely inefficient manner, certain limited local conditions.

The French authorities found it necessary to undertake works to protect their new proteges from the annual menace of famine and, as soon as the map of Tonkin on the scale of 1 : 100,000 (about 16 miles to the inch) and of the Delta on the larger scale of 1 : 20,000 (about three miles to the inch) were published, the department of public works immediately busied itself with this question.

In 1903 regular measurements were undertaken of the rainfall, humidity of the atmosphere and of the heights of the rivers.

The Delta produces two crops of rice—one known as the fifth month crop and corresponding to the dry season and the other known as the tenth month crop, corresponding to the rainy season. Irrigation is wanted more or less solely for the earlier, and it can be carried out by gravitation or by pumping.

(A) Irrigation by Gravitation

The earliest preliminary trials were undertaken over a limited area in the plain of Kep in the province of Bac-Jiang.

The water was taken from the Song-Thuong in which a dam 460-ft. long and having an over-fall of 230-ft. was built, the water being brought by a canal five miles long to the head of the area of distribution, en route another over-fall of 177-ft. practically kept the water of the canal at one constant level.

The canals in the irrigation zone were as follows :

1° A main canal of 20½ miles ;

2° 20 miles of arteries, and smaller arteries ;

3° A network of still smaller arteries of a total length of about 186 miles. This has been at work since 1914 and includes : dams and over-falls on the main canal, sluices at the beginning of each large or small artery, syphons, aquaducts, races, water-chutes, iron and masonry bridges and wooden foot-bridges, the whole covering 18,534 acres.

The cost of construction was 675,599 piastres or 36.5 piastres per acre irrigated, and the yearly upkeep amounts to about 405 piastres per acre.

This irrigation on the plain of Kep has shown the great value of irrigating the land in Tonkin, for worth but 25.3 piastres an acre before the work was commenced, it now fetches about 81 piastres and its owners have become the best customers for phosphated manures.

Such a conclusive trial has naturally led to further schemes and at the present time irrigation works covering an area of about 42,000 acres have just been opened at Vinh-Yen ; this comprised the building of a dam and the cutting of a network of canals, as well as the construction or all other necessary works. The work commenced at the end of 1914 have been recently (1922) opened. The total cost was estimated at 1,100,000 piastres or 26.2 per acre irrigated.

Further, work will shortly be begun on another scheme on the Song-Kau including a navigable canal between Thai-Nguyen and Phu-Lang-Thuong and permitting of the irrigation of 84,000 acres, the cost of which is estimated at 3,000,000 piastres.

(B) Irrigation by Pumping

Irrigation by gravitation is not always possible and in many cases pumping must be resorted to. Experiments have been made at Phu-Xa, immediately above Hanoï which have determined the amount of water required and the cost of carrying out such pumping work. On these data the following schemes have been proposed :—

North Kesat	98,850	acres
South Kesat	197,700	,,
North Bac-Ninh	111,200	,,
North Hadong	76,600	,,
South Hadong	51,000	,,
Sontai	34,600	,,
North Sontai	24,700	,,
Phu-Tho	24,700	,,
Total	620,250	acres

The estimates amount to 11,475,000 piastres or 18.8 piastres per acre.

(C) Drainage

A fresh problem has to be solved in the lower delta, which is cut up by numerous water-ways into "compartments" protected against floods by dams. Rain-water has to be drained from these "compartments" and this is at all times difficult on account of the dams and impossible in time of flood owing to the height of the water in the canals which form their lines of demarcation.

Works undertaken in the Hanoï "compartment" of about 250,000 acres and bounded by the Red River, the Dai and the Phu-Li canal have already improved some 74,000 acres, and by pumping it is hoped to improve another 98,850 acres. This first amelioration has been arrived at by widening and clearing the canals in the "compartment," isolating certain secondary "compartments" and constructing weirs.

(D) Keeping Out Salt Water

Works for protecting the "compartments" of Song-Da-Lo (Kien-An), Doson (Kien-An), Vinh-Bao (Haiduong), Tien-Hai and Truc-Ninh (Thai-Binh) and of Kim-Son (Ninh-Binh) from salt or brackish water have already been carried out and consist principally of the construction of embankments and evacuation sluices on ground recently won from the sea. A supplementary system of irrigation canals brings the necessary fresh water for the crops.

II. Annam

Annam consists of a narrow strip of lowland lying between the sea and the Annamite chain of mountains which here and there throws out spurs running down to the coast. The cultivable land is to be found in the deltas of the short torrential rivers running down from the mountains.

Here, where rain falls much more irregularly than is the case in Tonkin irrigation becomes of greater importance. As a rule agriculture is possible only during the rainy season and the one harvest is often spoilt, so that in this strip of country with one of the heaviest rain-falls in the world a comparatively short drought may cause a famine.

The Annamites, after driving out or absorbing the Chams, who certainly understood irrigation better than their conquerors, have gone in this direction only so far as their feeble tools allowed, and it became incumbent on the French authorities to do something towards irrigating the series of little deltas, wherein are to be found the arable lands. Irrigation works in the province of Thanh-Hoa were the first to be undertaken and they comprise : a dam on the Song-Chu, hydro-electric works on the main canal thus formed and a network of smaller irrigation canals for the irrigation of some 123,500 acres by gravitation and 49,400 acres by pumps driven by power derived from the electric station. The first cost is put at 3,500,000 piastres for the acreage irrigated by gravitation (28.3 piastres per acre) and 1,000,000 piastres for that irrigated by pumping (20.2 piastres per acre), and the works begun in 1918 should be completed in 1923.

Work is in progress on a scheme for irrigating 49,400 acres by gravitation in Phu-Yen taking its water from the Song-Da Rang.

The public works department proposes to carry out the following schemes :—

1° By gravitation :

Kwang-Ngai	74,100 acres
Hue	37,050 ,,
Kwang-Nam	74,100 ,,
Nhatrang Phanrang	49,400 ,,
Total	234,650 acres

The estimated cost, including the irrigation of the Phu-Yen, amounts to $8,600,000.

2° By pumping:

Hatinh	98,850 acres
Hué	37,050 ,,
Vinh	123,550 ,,
Kwinhon	49,400 ,,
Kwang-Nam	74,100 ,,
Total	382,950 acres

At an estimated cost of $7,000,000.

III. Cambodia

Irrigation is as necessary in Cambodia as in Tonkin and Annam, as the rains are very irregular and the advantages to be derived therefrom are quite as important.

A scheme has been proposed for the irrigation of some 197,700 acres by a canal from the Preck Knot, the cost of which is estimated at $6,000,000.

Previous to this a scheme was proposed to cut an irrigation canal from above the falls at Khong on the Me-kong, but this has been abandoned in favor of an electric station utilizing the falls at Sambor and supplying power for irrigating by pumping the lands bordering on the Me-kong, and it is expected that some 1,235,600 acres could be irrigated at a first cost of $23,000,000.

IV. Cochin-China

In this country successive budgets have provided funds for maintaining and cutting large canals for regulating the tidal waters, as well as the floods of the Me-kong, for the benefit of existing and proposed rice-fields.

These canals will serve at the same time for the circulation of the natives and for the transport of goods and produce of the soil to the various local markets and, especially as regards rice, to the factories and over-seas quays of Cholon-Saïgon.

These water-ways are an essential organ of the life and development of Cochin-China. For the last twenty-five years the network has been systematically increased and forms a striking feature of the country, admired alike by the natives and by foreign visitors. The report of the last colonial commission of inspection calls attention to these water-ways and to the methodical way in which they have been developed by the government of Indo-China.

In the canals uniting two rivers in which tidal action is felt, this current enters from the two ends, carrying with it a light mud and depositing the same where the two currents meet, which is practically always about the same spot, forming here a shoal of mud. To avoid the formation of these shoals, with their attendant disadvantages the public works department, which has studied the problem since 1880, decided to form basins at the neutral points wherein the mud would be naturally deposited, and the first works of this kind were carried out in 1891 in the Duperré Canal and were followed by similar undertakings in the Saintard Canal, in the Chinese Arroyo, at a second point on the Duperré Canal, on the Mangthit and on the Lapvo Canal, all of which proved highly satisfactory.

Before the arrival of the French, the Annamites constructed, maintained and improved the canals as best they could with the very limited means at their command, with the result that as a rule these water-ways were much too small. In 1884 the French authorities bought dredgers and later bids were asked for in Paris for the dredging of the canals of Cochin-China. This work was commenced in 1894, the contract amounting to 12,000,000 francs and at the same time the Authorities carried out dredging operations according to a fixed schedule with its own dredgers. Work has been continued ever since, successive contracts having been let to a French Company. The most recent contract is for the five years ending December 31, 1926 and the minimum yearly expenditure is fixed at $1,200,000 for the large water-ways and $70,000 for the smaller ones making at total of $6,420,000 for the whole period.

The latest program is for the same five years and the expenditure is estimated at $7,250,000 of which $6,000,000 will be provided by the general budget of the union and the remainder by the local budget of Cochin-China. This includes the dredging of some 86,325,000 cubic yards in existing canals at an estimated cost of $2,650,000, and the improvement of existing ways in the Plaine des Joncs, as well as the cutting of new canals. The public works department of Cochin-China is actually engaged in making a complete map with contour lines of the Plaine des Joncs.

It may be mentioned that dredging operations were pushed forward in 1920, 9,367,582 cubic yards being dredged at a cost of $1,296,104.

The usefulness of these canals may be measured by the increasing exports of rice which rose from 500,000 tonnes in 1898 to 1,020,000 in 1920 and over 1,500,000 tonnes in 1921. At the same time these increased facilities for irrigation have made it possible to cultivate sugar-cane, cotton and coco-nut palms.

Appendices

1. Table showing existing and proposed irrigation works :
2. Map showing the river dams in Tonkin :
3. Map of the canals in Cochin-China.

Irrigation Works in Indo-China

A.—Tonkin.

I. *Existing Works.*

Kep	18,534 acres	By gravitation.	Cost $ 675,000

II. *Works in Progress.*

Vinh-Yeh	44,481 acres	By gravitation.	Cost $1,100,000

III. *Proposed Works.*

Song-Kau, left bank	84,000 acres	By gravitation	...Cost $3,000,000
Song-Kau, right bank	96,400 ,,	—	— $2,925,000
Kesat, north	123,550 ,,	669,650 acres By pumping	...Cost $11,475,000
Kesat, south	197,700 ,,		
Bac-Ninh, north	111,200 ,,		
Hadong, north	76,600 ,,		
Hadong, south	76,600 ,,		
Sontai	34,600 ,,		
Sontai, north	24,700 ,,		
Phu-Tho	24,700 ,,		
		Total for Tonkin	$19,175,600

B.—Annam.

I. *Works in Progress.*

Thanh-Hoa	123,550 acres	By gravitation	...Cost $3,500,000
—	49,400 ,,	By pumping	... — $1,000,000

II. *Proposed Works.*

Kwang-Ngai	74,000 acres	283,800 acres By gravitation	...Cost $8,600,000
Hué	37,000 ,,		
Phu-Yen	49,400 ,,		
Kwan-Nam	74,000 ,,		
Nhatrang Phanrang	49,400 ,,		
Hating	98,850 ,,	382,800 acres By pumping	...Cost $7,000,000
Hué	37,000 ,,		
Vinh	123,550 ,,		
Kwinhon...	49,400 ,,		
Kwang-Nam	74,000 ,,		
		Total in Annam	$20,100,000

C.—Cambodia.

Proposed Works.

Preck Knot	197,700 acres	By gravitation	...Cost $ 6,000,000
Me-Kong...	1,235,000 ,,	By pumping	... — $23,000,000
		Total in Cambodia...	$29,000,000

D.—Cochin-China.

Proposed works	$ 8,000,000
Grand Total	$76,275,600

Hydro-Electric Developments in N.E.I.

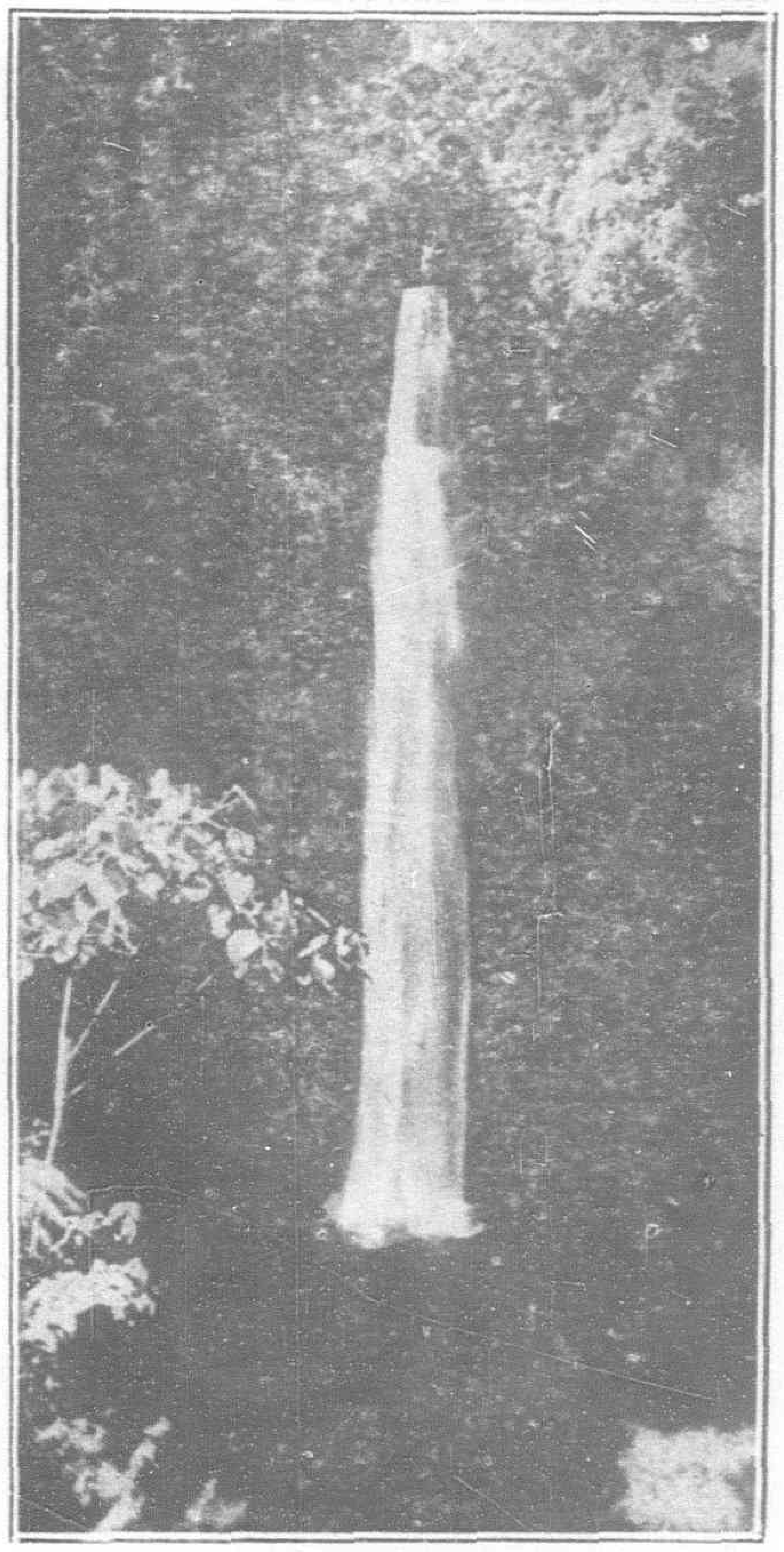
The Electrification of Railways Already Well Under Way

By Richard Hoadley Tingley

THE coal resources of the Dutch East Indies are limited and largely undeveloped. That the home supply is insufficient to meet the demand is evidenced by the fact that this colony annually imports from 200,000 to 500,000 tons, and exports none. The principal mines, owned and operated by the government, are the Ombilin, near Padang on the west coast of the island of Sumatra; the Boekit Asem collieries near Palembang, toward the east coast of the same island; and those on the small island of Pulo Laut off the southeast coast of Borneo. The total annual production of these mines is barely 500,000 tons—a large portion of which finds its way to the sister island of Java, the largest user of coal, where practically none is mined.

Fall in Tji Saroena, West Java

Fall Near Dago, West Java



Fall in Tji Mahi, near Tpisaroena, West Java

Recognizing the folly of continuing to import coal while permitting its many water-power resources to remain in an undeveloped state, the government, in 1910, organized a new branch of service and appointed Mr. P. A. Roelofsen, C.E., now director of public works, director of the department of water power and electricity, with instructions to report upon the hydro-electric potentialities of the Dutch East Indian possessions as well as upon the water-power sites already developed.

Mr. Roelofsen's report, which does not include certain of the innumerable lesser islands or much of the little-known part of Dutch New Guinea, summarizes the hydro-electric possibilities as follows:

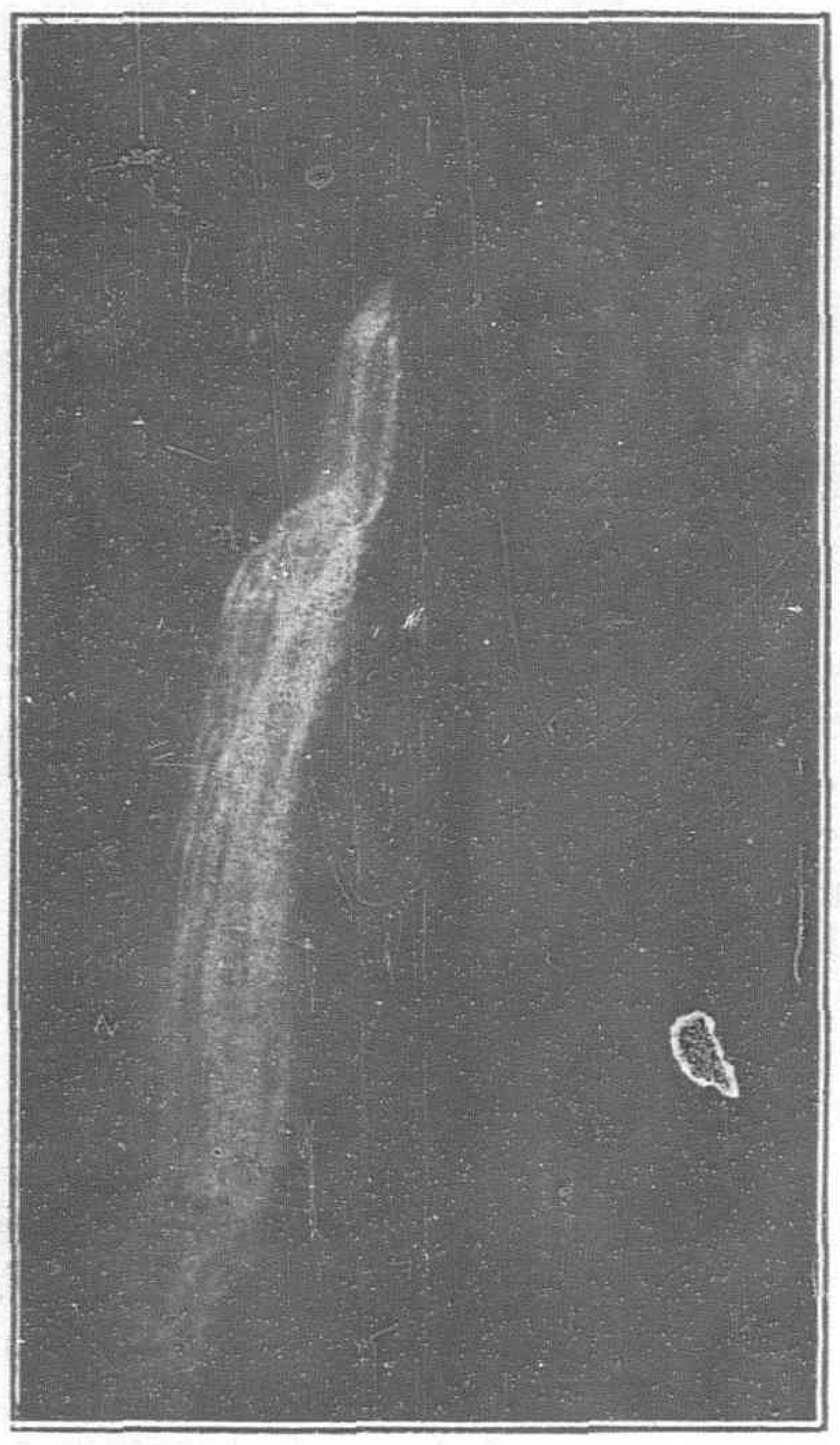
Java	500,000 h.p.
Sumatra	2,000,000 ,,
North Borneo	2,000,000 ,,
Celebes	1,000,000 ,,
Total	5,500,000 h.p.

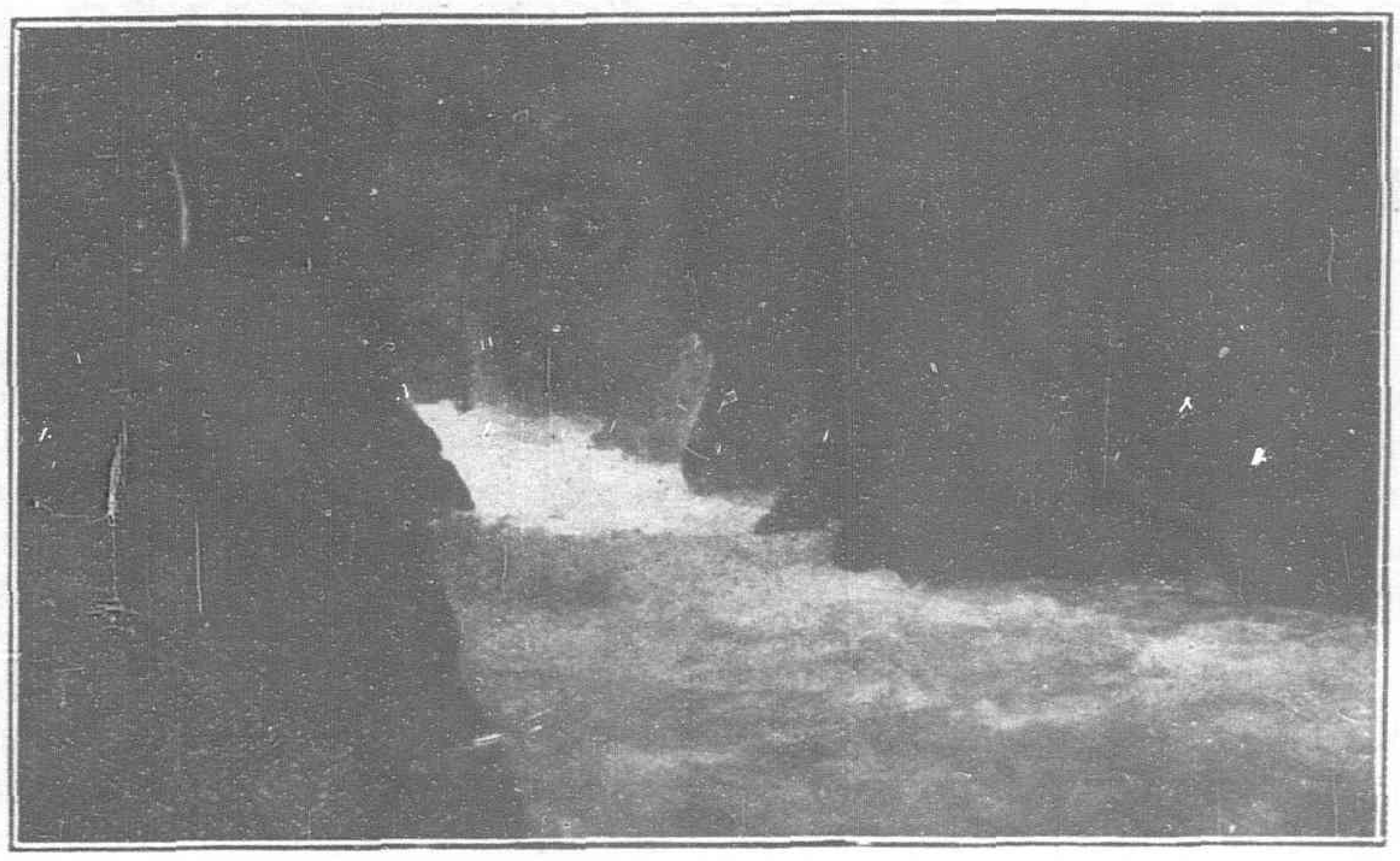
We shall say but little about any of the islands except Java. The others referred to are largely undeveloped, and it will be many years before any of them will be so advanced that it will be practicable to utilize even a small portion of the water-power resources accredited to them. With Java, however, the case is different. This island has a population of about 33,000,000—710 to the square mile, and is by far the most densely inhabited country in the world. Its nearest approach is Belgium, with 650 people per square mile. Of this population, about 110,000 are whites, who are an important factor in the commercial life of the island, while the rest are native Javanese with a sprinkling of Chinese and other Asiatics.

Java is the garden spot of the Dutch East Indies and the most highly developed of the islands. In size it is about equal to that of the state of New York. From the shore line to the base of the mountains that form the backbone of the island, intensive cultivation is in progress the year round and there all the agricultural products are raised for domestic use and for export. So important and valuable are these that Java has been able, in consequence, to maintain for many years a favorable trade balance with the outside world.

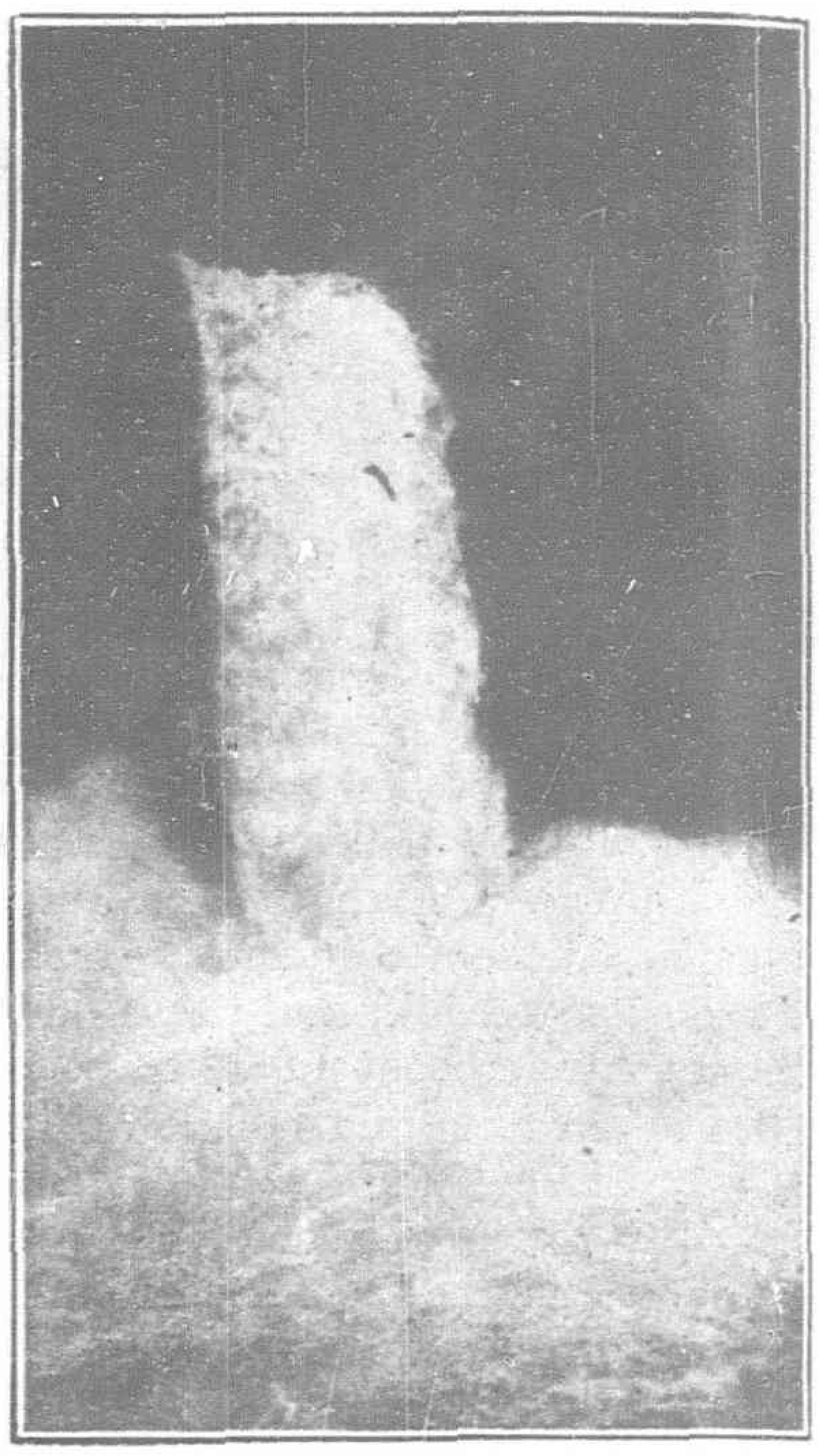
Railway construction began in Java in 1878 with a short section of 36 miles from Surabaya to Passoeroean. Since that time a system of about 3,000 miles has been built—1,550 miles of which is owned and operated by the government and the remainder by twelve private companies. The greater portion of this mileage is of their standard gauge, that is, three feet six inches. A small part, however, is distinctly narrow gauge, about two feet, and another small portion is equal to the United States standard of 4 feet 8½ inches. Some idea of the comparative extensiveness of Java's

ASAHAN RIVER



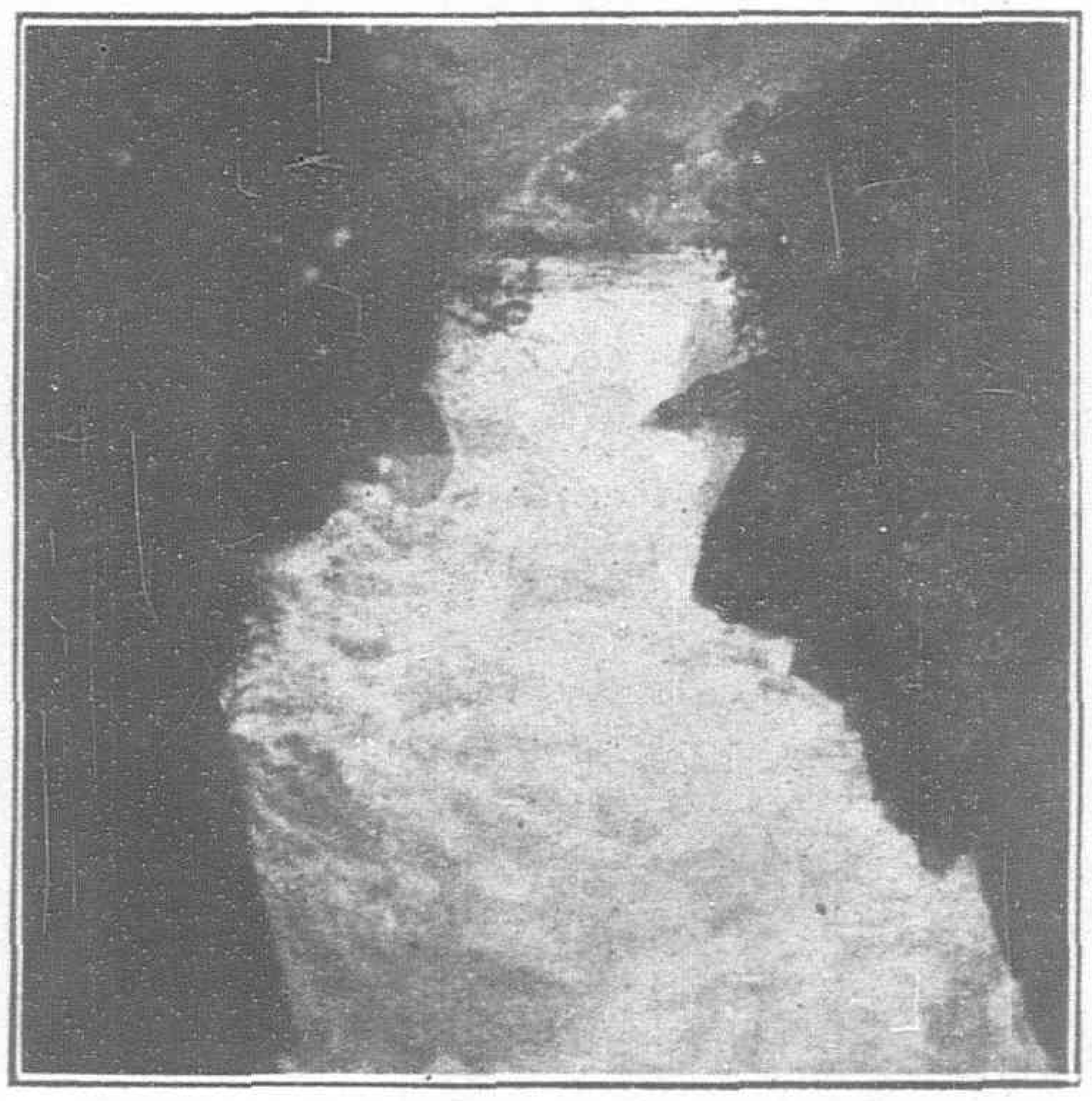


Near Gala-gala, Sumatra

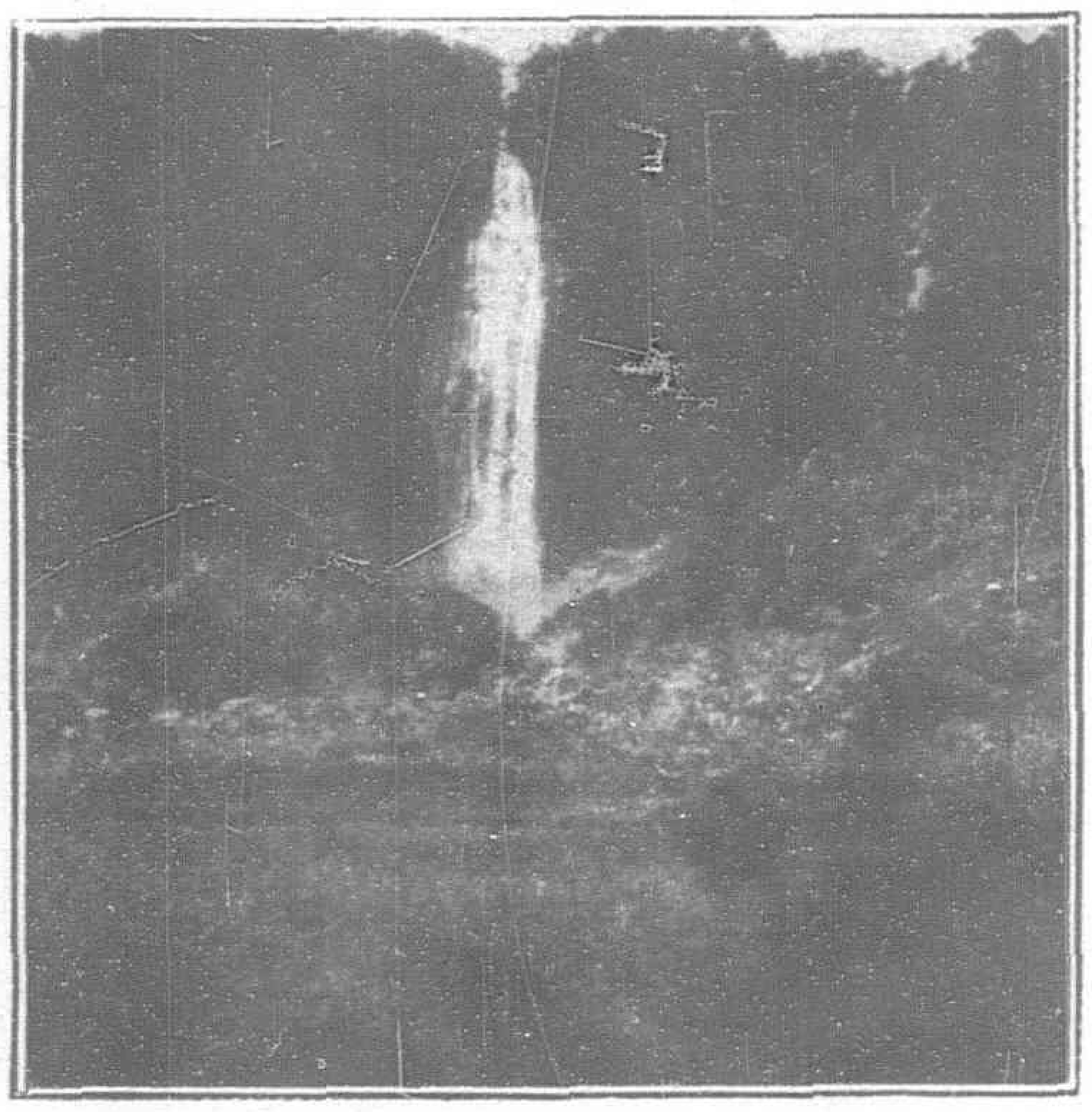


Left: Fall of Aek Tonot, near Tangga, Sumatra

Right: Asahan Falls, near Tangga, Sumatra



Asahan River, Sumatra

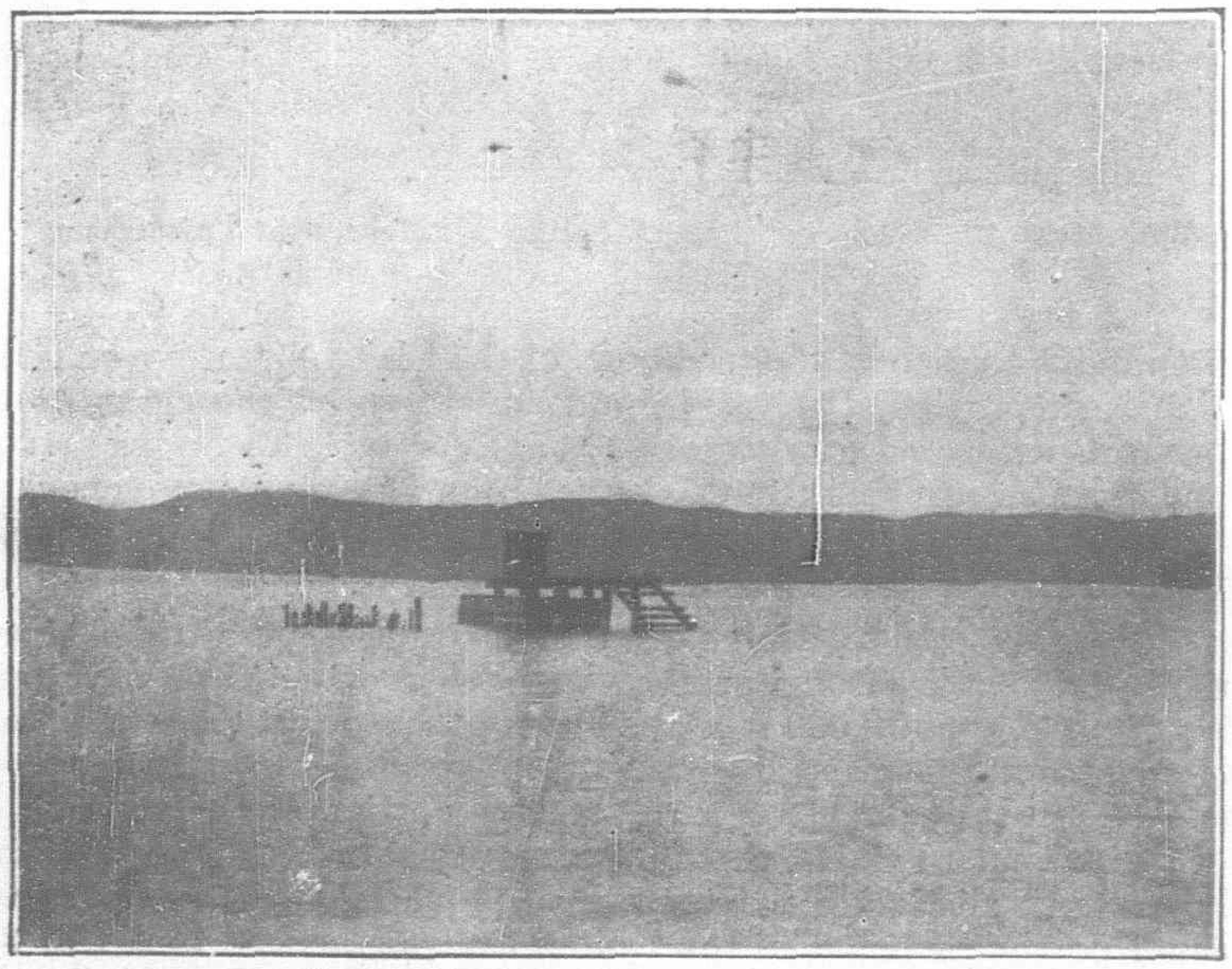


Fall of the Ack River, near Tangga, Sumatra

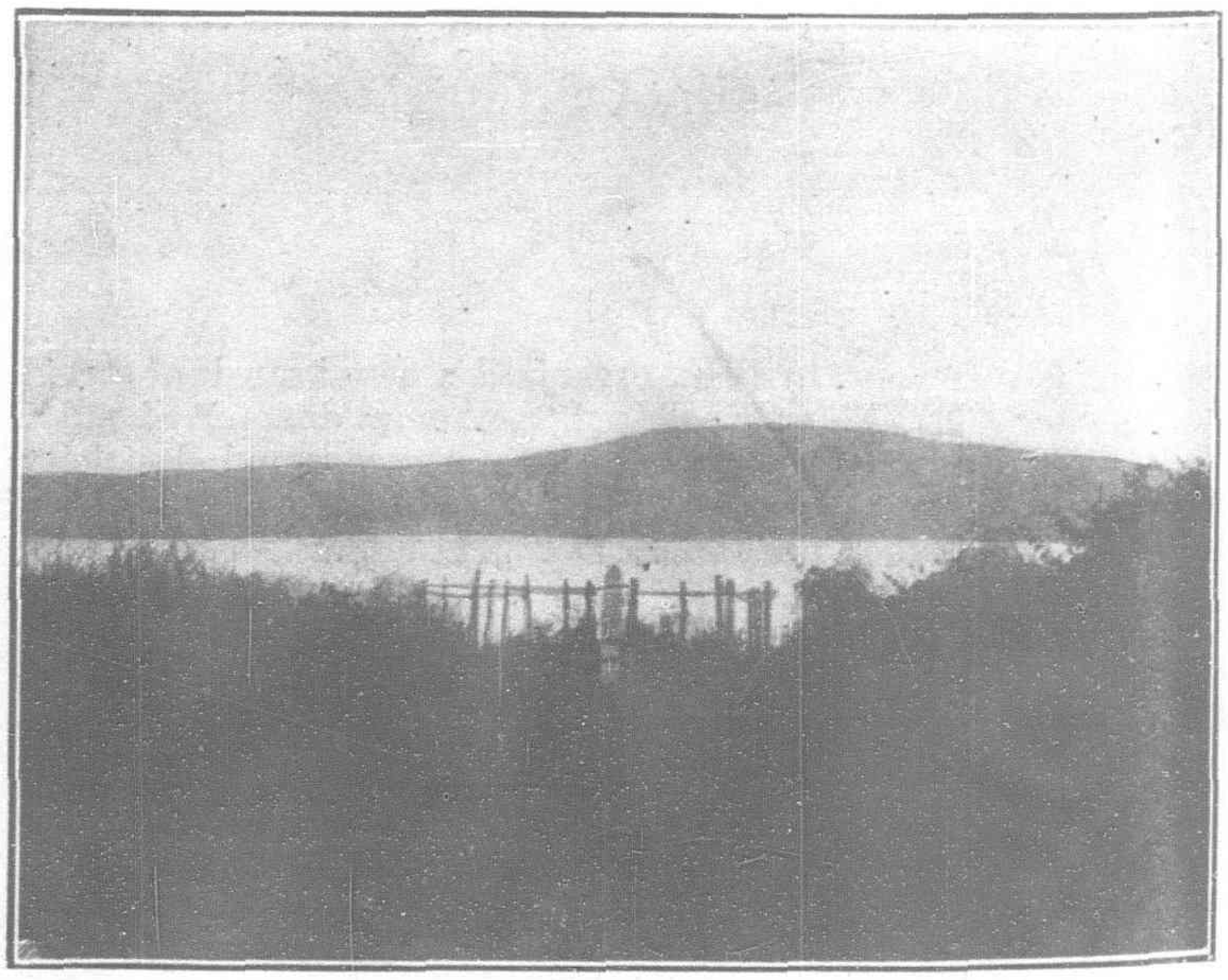
railway development may be had when it is realized that this island maintains a mile of track for each seventeen square miles of its area as against a mile for each twelve square miles in the United States.

Java is about 600 miles long and has an average width of something less than 100 miles. For fully half of its western length it is traversed by two railway lines, which are approximately 60 to 80 miles apart, while its eastern end is served by a single main line. Throughout the island there are many branches, running north and south, which connect important sections. The roadbed is excellent, the service is good, and the companies are prosperous. At present it takes a day and a half to travel from Batavia, on the west, to Surabaya, on the east. For economic reasons, unknown to the writer, Java trains do not run at night; and a through passenger is, therefore, obliged to spend the night at some city en route.

The department of public works estimates that if the available water power were developed to capacity—50,000 h.p., it would be sufficient to operate the entire railway system and to leave, besides, a surplus for industrial and public-utility uses. A carefully worked out plan has been prepared looking to that end which, it is hoped, will be fully realized in about ten years, or sooner, should financial conditions warrant. In this manner the Dutch East Indian government hopes to be able to stop the importation of coal—thus saving that product for other uses and for export.



Autographic Water Stage Register in Lake Matano, Celebes

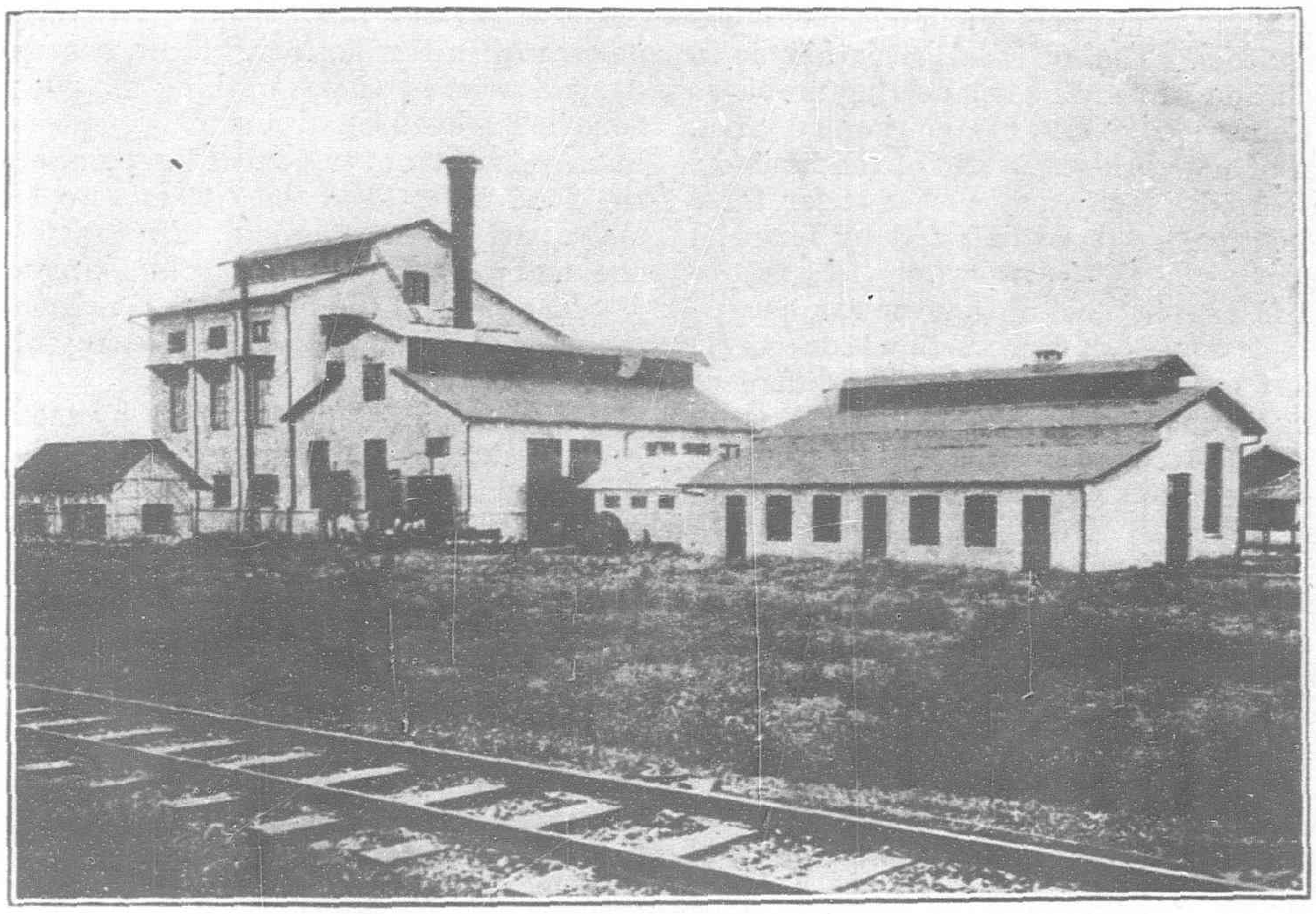


Rain Gauge, near Lake Matano, Celebes

In the nature of things, however, Java's water-power resources are small. The drainage basins are restricted in area because the streams all flow in a generally north or south direction—the short way of the island. This deficiency is partly overcome by a very heavy rainfall—which ranges from an average of 120 to 160 inches annually and reaches, occasionally, as high as 320 inches in the more mountainous regions—and by the high head of many of the steams as they tumble down the steep slopes.

Java's dry season occurs in May, June, and July, while its period of greatest precipitation is in November, December, and January. The normal average flow of the streams is rated at 175 second-feet—reaching 700 second-feet at times. It is estimated that the largest single source of water power is capable of developing about 50,000 h.p. The majority of the prospects, however, are rated at from 1,000 to 5,000 h.p. Most of the developed and undeveloped hydro-electric resources are in western and central western Java.

The principal activity in Java's water-power development is centred, at the present time, in the westernmost end of the island where two power stations are being constructed—a portion of the current there generated to be utilized in operating the existing railway line running from the harbor of Tandjong Priok, through Batavia, Weltevreden, Buitenzorg, thence southerly and easterly toward Bandong, a total distance of about 60 miles. The larger of the hydro-electric stations is at Tji Anten (*tji* meaning river), some twelve miles west of Buitenzorg, and has a capacity of 25,000 h.p. The smaller one at Tji Tjatih, about 30 miles south of Buitenzorg, has a capacity of 15,000 h.p. It is expected that these stations will be in full operation, and the railway lines electrified, some time in 1923, thus forming the first link in the chain of electrification which will extend eastward, 500 miles, to Surabaya. The work is in charge of Dr. J. N. Van Der Ley, who succeeded Mr. Roelofsen in this branch of the service.



The N.E.I. Government Steam Central Electric Power Plant at Dajeu-kalot

The primary power developed at each station is of 70,000 volts, 3-phase, 50 cycles. For railway use the current is transformed to 1,500 volts for distribution and further transformation. Much of the equipment for the power houses and transmission lines is being purchased in the United States. This includes 60 galvanized-steel towers, each 75 feet high, equipped with three cross-arms for a double 3-phase line. Upwards of 900,000 pounds of hard-drawn copper cable has also been bought in America. This cable is of two sizes, that is, 50 and 70 square millimetres, and each is composed of seven wires. Furthermore, the United States will furnish much of the smaller power-house and transmission-line material. There was lively competition between Europe and the United States to get the contracts for much of the larger equipment, and in this bidding the homeland, Holland, obtained a preferential, sometimes as high as 15 per cent., over other countries, notwithstanding the long-established free-trade policy of The Netherlands and her colonies.

In addition, there are under construction state hydro-electric stations on Tji Kapoendoeng, near Bandong, to be of 3,000 h.p. capacity, and on the Tji Saroewa, near Pangalengen, of 4,500 h.p. Farther east two small stations are being built—one, an auxiliary plant of 400 h.p. on the Tji Hapit, at Bandong, and another of about 1,000 h.p. for radio purposes south of Bandong. All the stations already built or under construction have been planned to fit into the general developmental scheme of the island, and are to be so interlinked that they will be able to assist one another in times of need.

Perhaps the most important of the hydro-electric plants already operating in Java is that in the Tjatoer valley, near Madiun. At Madiun are located the extensive shops of the government railway; and the increased traffic in 1911 and 1912 made the enlargement and remodeling of these shops a necessity. In 1914, therefore, the government decided to make the improvements and extensions, and adopted the recommendation of Director Roelofsen that they be electrically equipped throughout. Previous to this time the available water power of the Tji Tjatoer had been fully investigated, and work on the project was started. Since March, 1917, this station has been in continuous operation, and may be briefly described as follows:

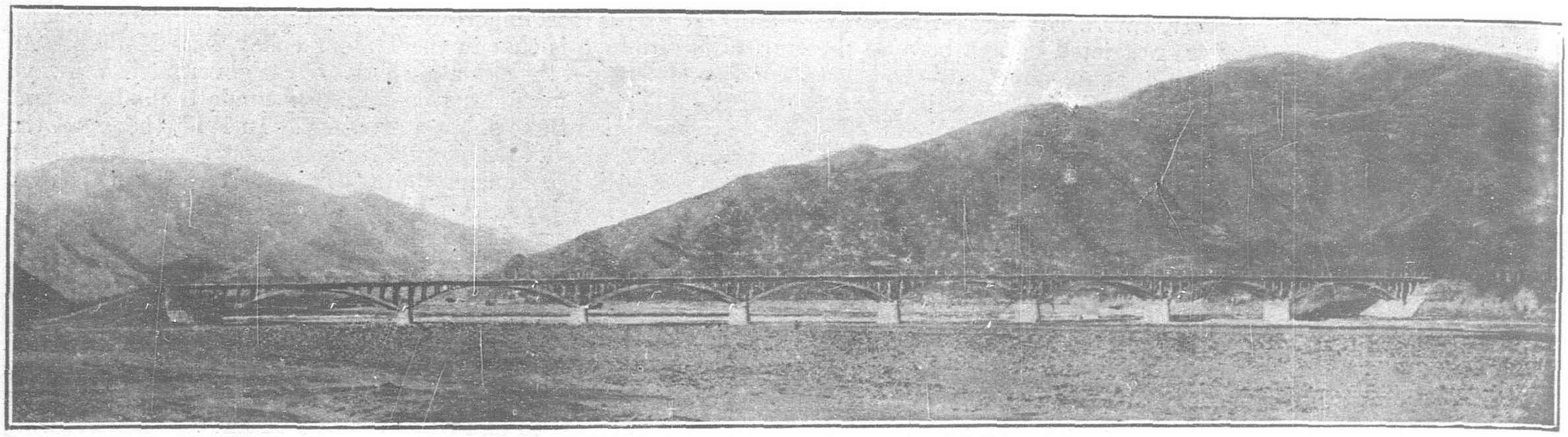
The Madiun plant generates current at 6,300 volts, transformed to 26,000 volts for transmission to town. The transmission line is seventeen miles in length, and the steel towers, which are 128 feet apart, are arranged to carry two 3-phase circuits. The net head, after deducting all losses, is about 100 metres, and the entire plant is capable of supplying 2,000 h.p. from two turbines when sufficient water is available. Six years of observation and stream gauging have determined that the full capacity of the turbines could be relied upon for but 6½ months in an average year; and the station is now operating under these conditions. The department, however, expects to augment the capacity of the plant at some future date so that 2,000 h.p. may be delivered continuously the year round. It has not yet been determined, however, whether this will be done by installing a steam auxiliary or by building storage reservoirs farther upstream. At present, power is supplied only to the railway shops. As soon as the maximum current of 2,000 h.p. is available throughout the year, the city of Madiun will be provided with electricity for lighting.

One of the problems in designing water-power plants in Java is that of silt and gravel which these mountain streams carry in their tumultuous course. This has been solved on the Tjatoer, and at the other plants, by building sedimentation reservoirs where the velocity of the water is checked and the sediment is allowed tosettle. From thence it can be readily removed.

A concession has been granted to the General Netherlands Indian Electric Company and construction has been begun by them on a hydro-electric plant of 2,200 kilowatt capacity at the falls of the Tji Toentang south of Samarang, the purpose being to supply that city and Salatiga with light and power. This company has further plans which include power developments and irrigation projects on the Rawa Pening, near Ambarawa.

In addition to the plants described there are many small water-power installations in Java which are owned and operated by private companies. These are principally found in the western part of the island and supply energy for various factory and agricultural purposes. Some of these power plants have been in operation 60 or 70 years, and there may still be seen many of the old wooden abreast and undershot wheels, attaining at times a diameter of 30 feet, with direct engine coupling used to drive rubber, tea, and coffee machinery, and rice hullers. Gradually, however, these ancient and inefficient wheels are being supplanted by modern turbines. In all, there are said to be about 160 of these small plants. In re-equipping them, a standardized plan has been largely adopted so that, when the general scheme for the expansion of the use of elec-

(Continued on page 535)



The Western Hills Bridge Near Peking

Reinforced Concrete Bridges in North China

By *J. J. Svagr, C.E.*

IN its present condition China offers few inducements for constructing engineers. The political situation is a barrier to the solution of pending engineering problems European and Chinese engineers are confronted with. The construction of new bridges is one of the foremost questions to be solved. Many projects exist for these improvements but then execution has been defeated by financial difficulties.

Reinforced concrete is a feature in most of these new projects.

The preference given to this method of construction is due to (1) a cheaper price, and (2) a short construction period. The difference in the latter point is striking : while iron bridges require 2½ years for their fulfillment, some of the reinforced concrete bridges have been achieved within *one* working season, i.e., *seven months*. Besides, there are other advantages in the use of the said material, which deserve to be mentioned : the maintenance is almost nil and the general aspect of such a bridge can be made more artistic, etc.

Characteristic of this type is the Western Hills Bridge near Peking in North China, as shown in the accompanying illustrations. This bridge consists of eight spans, each 100-ft. long ; the length of the bridge itself, including superstructures of the abutments, is 870-ft., the width being 20-ft. for the road and 5-ft. for the foot-paths resting upon brackets on each side, a total of 30-ft.

As the water level of this river during the greater part of the year is rather low, two piers only are covered with water ; but at the time of summer overflow the river takes in water running from the hills and becomes very dangerous, its rapid current being apt to turn stones of 2-3 tons weight. As a rule, the mountain rivers are supposed to have a solid ground ; this was the case for the above river too. In the very depth reached at the exploration, large-grained gravel has been found, which is rather rare for most of the rivers in South China. Therefore the piers have not been sunk to the rock, but placed from 20-ft. to 23-ft. from the river bed.

During the excavation work for adjustment of the first left side pier, the summer floods came on. The water did not rise gradually but a wave, like a huge wall of more than 21-ft. in height swept down with a terrific roar. The workmen, aware of the on-coming danger, warned those working in the pit. The latter had just time enough to climb out of the pit and the last workman just managed to run over a small temporal bridge to firm ground, when the flood water filled the pit and swept away the temporal bridge and a part of the cofferdam. Fortunately the loss was not a heavy one, and caused no delay in completing the bridge.

The piers of the bridge are constructed of reinforced concrete ; the part under the ground level being solid concrete, and the upper part, hollow.

The arches rest on the piers by means of hinges (crossed steel bars), system Prof. Mesnager.

In spite of a considerable variation in the summer and winter temperature, the hinges up to now do not show any visible alteration, i.e., *no cracks* in the concrete (admitted by the theory) at the hinge section have been found, even during hard winter frosts.

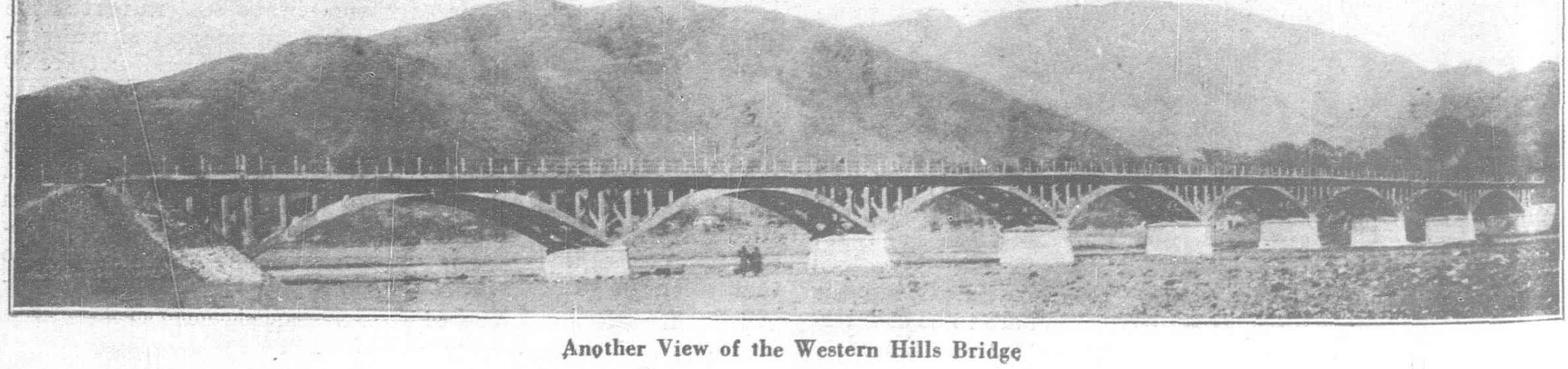
There are three arched ribs in every span ; pillars are resting on them supporting cross beams and girders of the superstructure. The end columns of each span are joined by a tie in the form of St. Andrew's cross.

With the exception of bannisters, made of iron-gas-pipes between concrete columns the bridge is all reinforced concrete.

The face of the bridge has no architectural ornaments but in spite of this presents a very attractive aspect. The plain outlines of the arches and the cement hue form a somewhat agreeable contrast with the woodless mountain site.

This bridge was constructed by Messrs. Brossard, Mopin & Co. of Tientsin, to plans drawn by the writer, and the construction work carried out under supervision of a qualified engineer, Mr. Gregoire. Owing to his systematic plan of working, the construction of the whole bridge was completed within seven months.

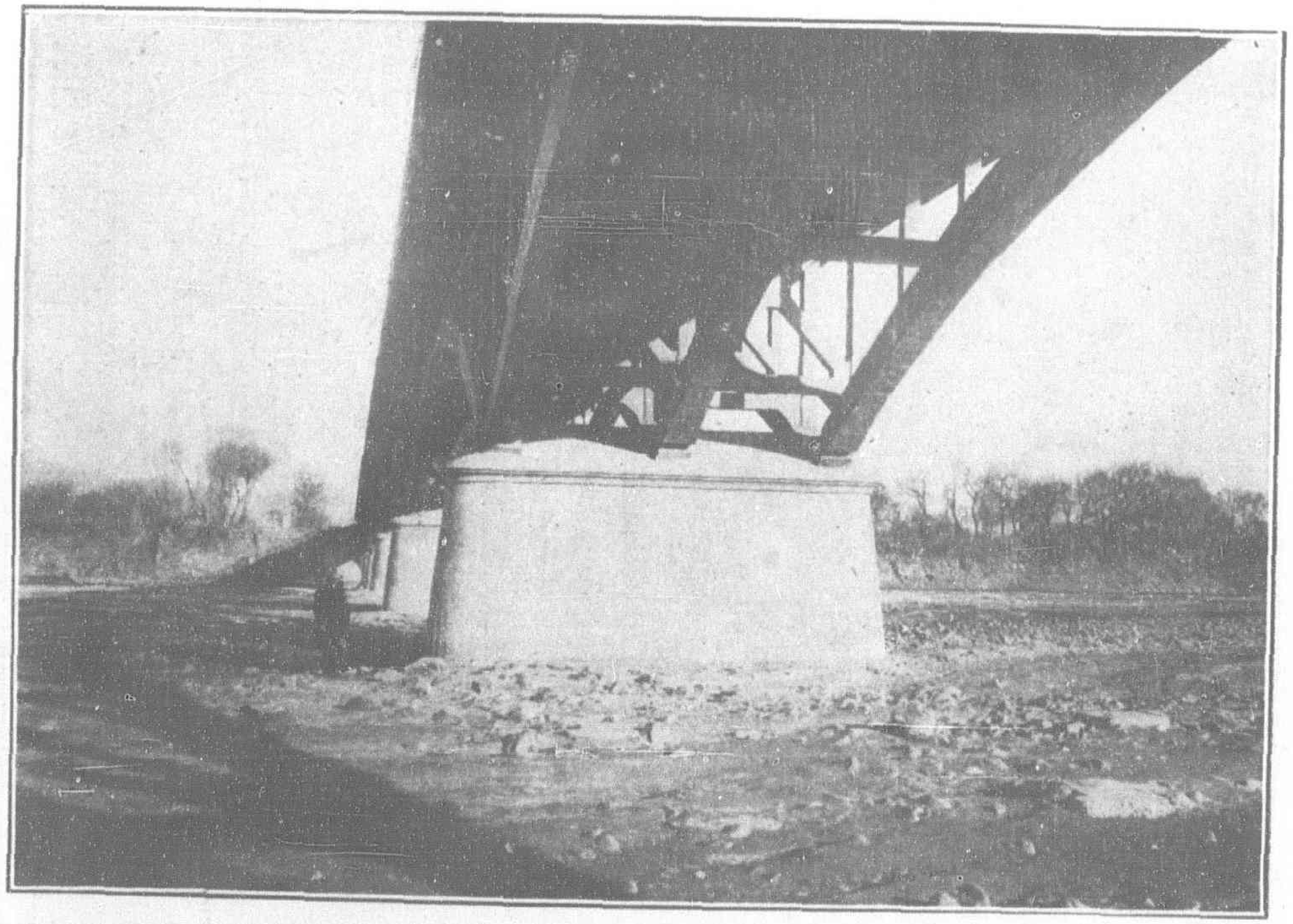
The description of some other bridges of the same type will follow in the next article.

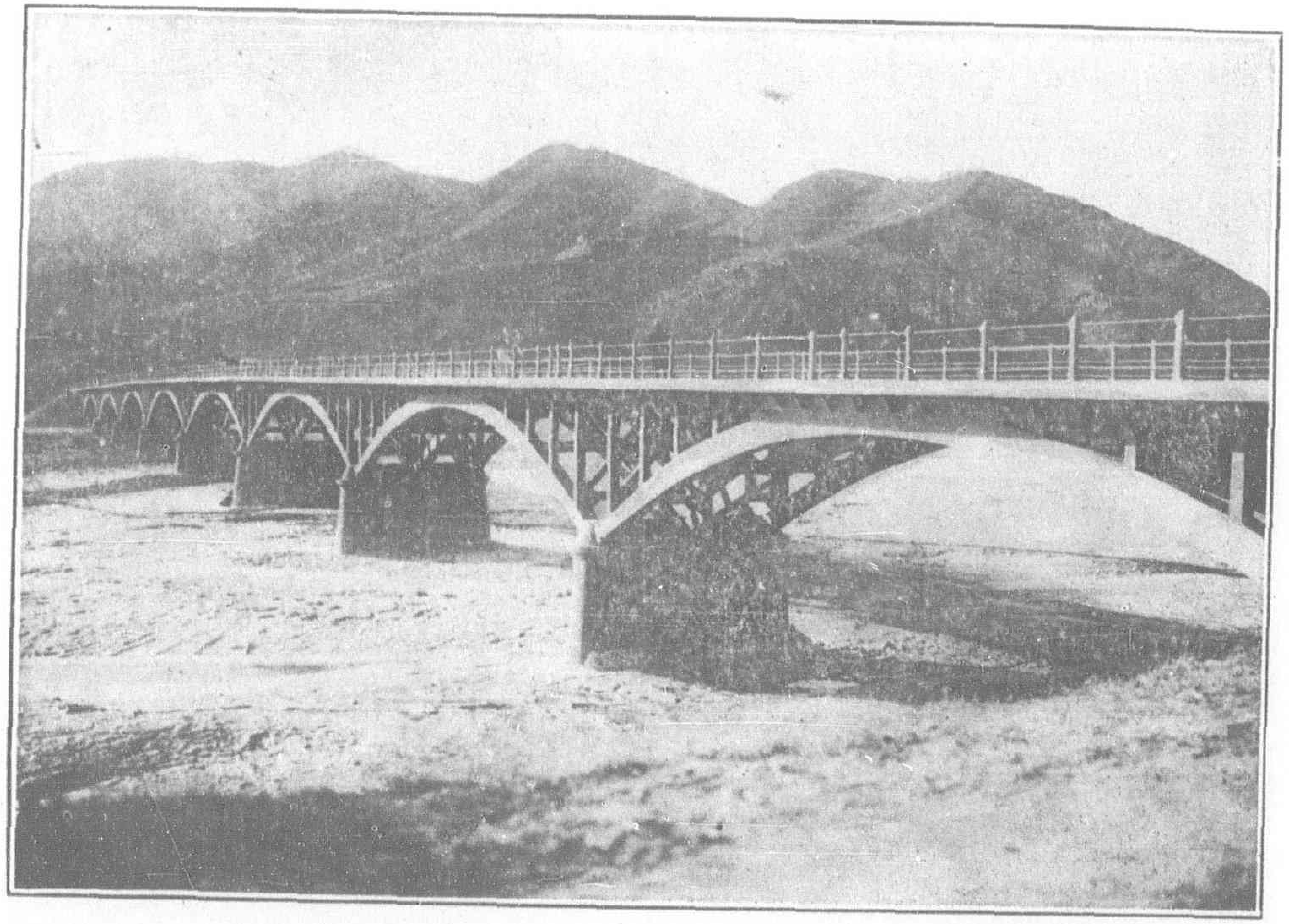


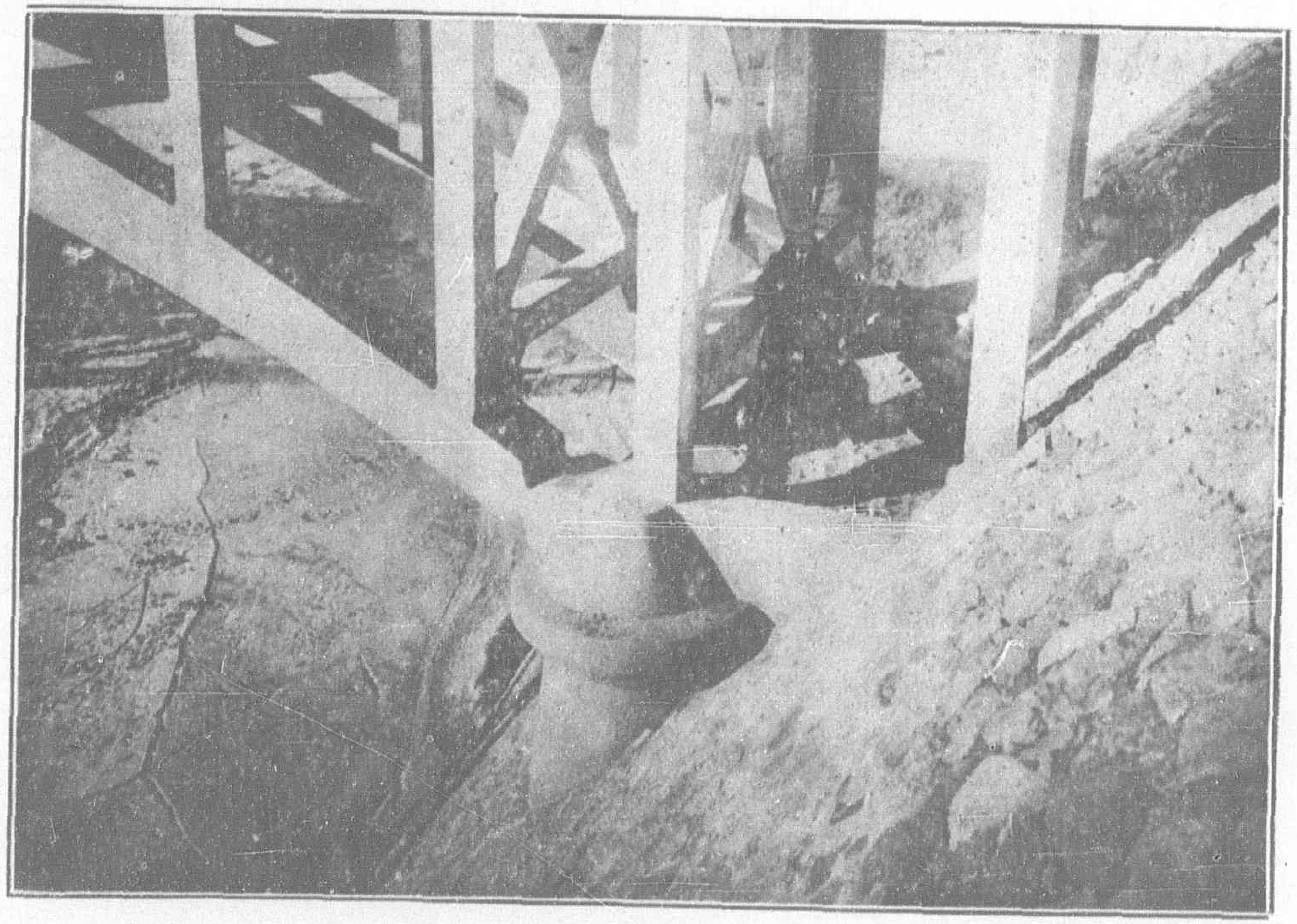
Another View of the Western Hills Bridge

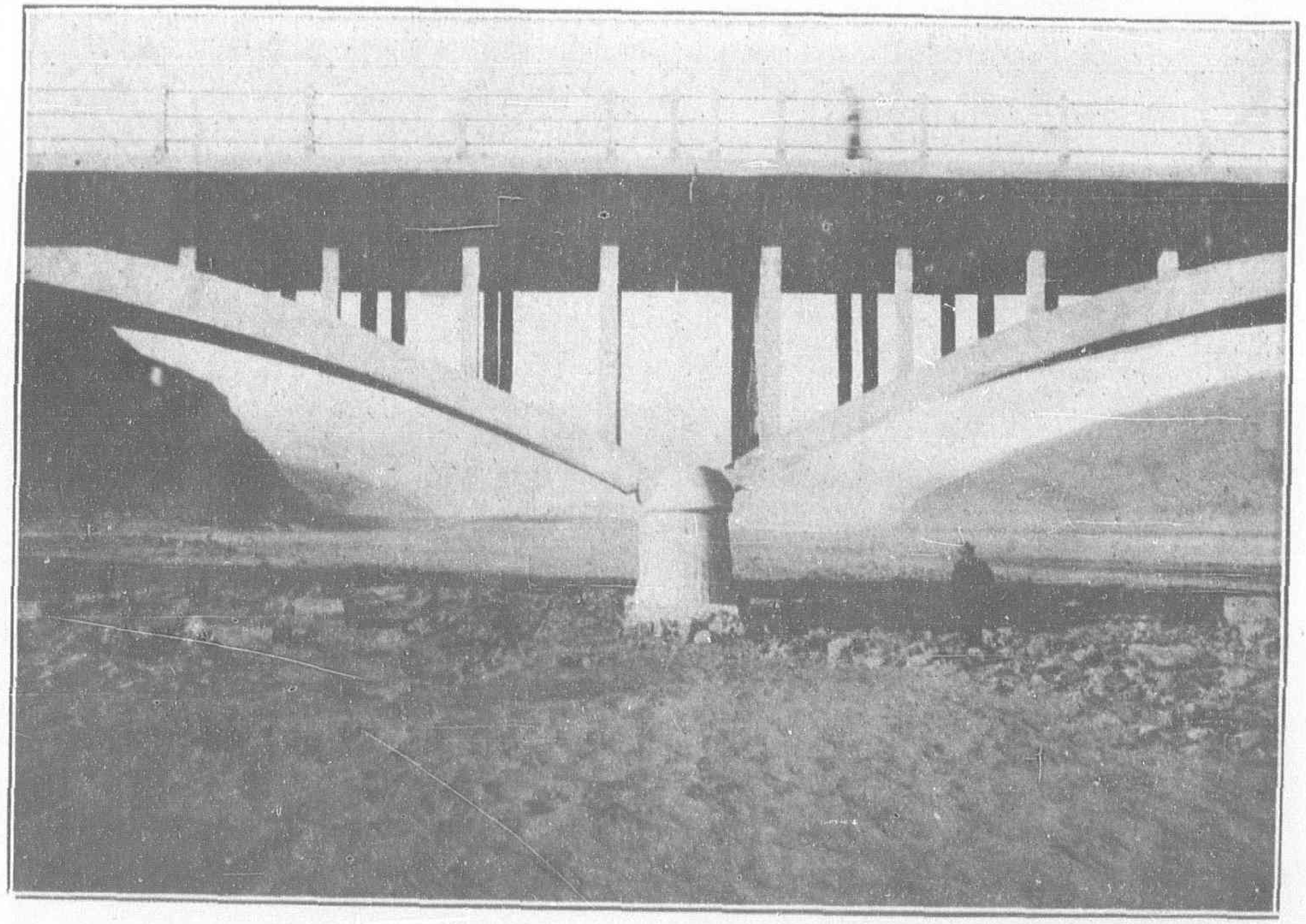
THE REINFORCED CONCRETE BRIDGE IN THE WESTERN HILLS

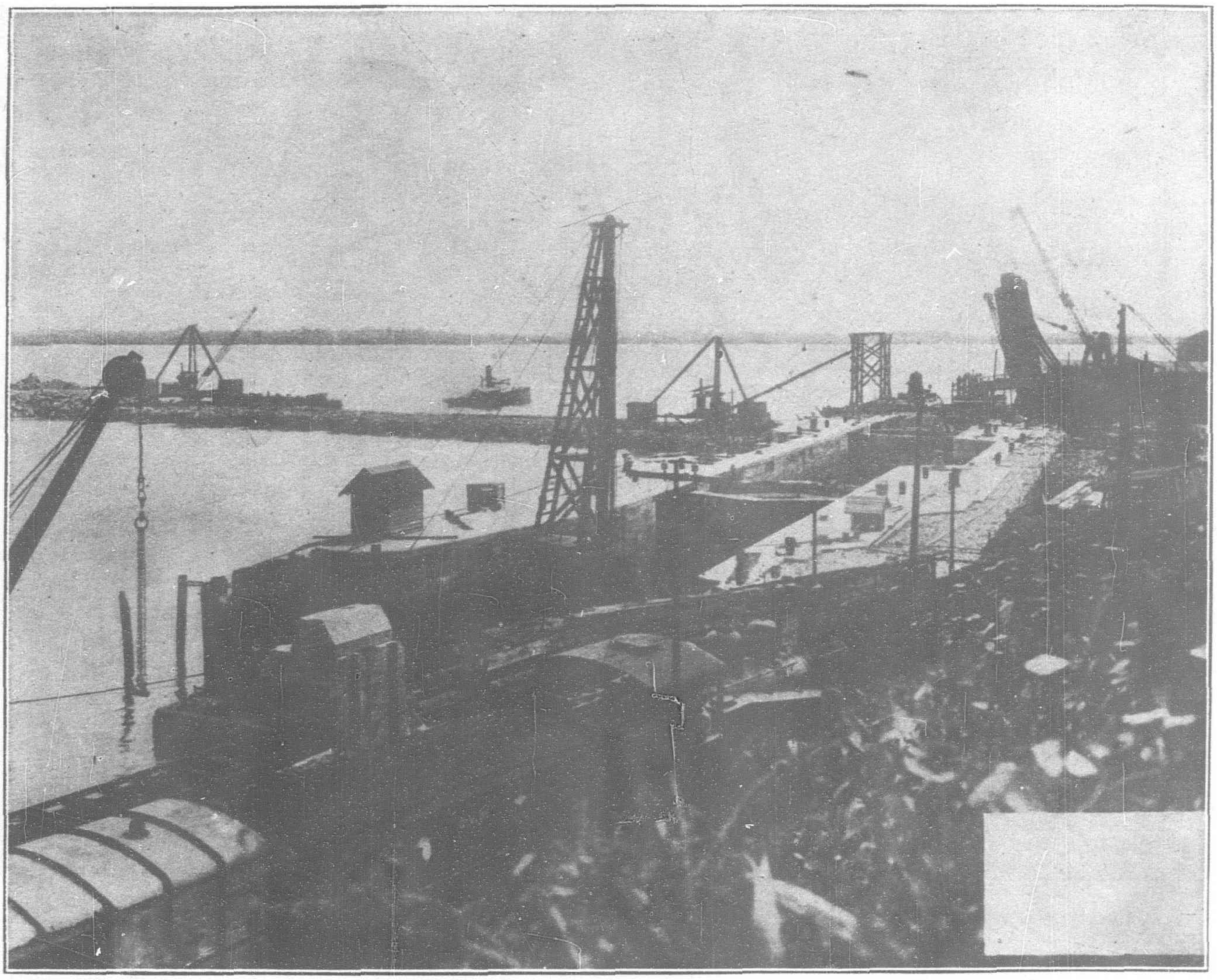
Designed by J. J. Svagr, C.E., and Erected by Brossard, Mopin & Co.











Johore Causeway: Northern End, showing the Lock for Passage of Coasting Vessels. This Lock is now in use. Photo taken December, 1922

Johore Causeway

By D. Paterson, Assoc. M. Inst. C. E.

SINCE the completion of the Johore State Railway in 1909 railway traffic has been carried on between Singapore and the Malay states across the Johore straits, which separate Singapore island from the mainland, by a system of ferry launches for passenger and luggage traffic and by train ferries for goods traffic.

In recent years this traffic has increased to such an extent that it has been a difficult matter for the railway departments to keep pace with the requirements. In 1921 in addition to passenger traffic, 58,402 trucks were transported across the straits, as compared with 44,226 in 1916, and further increases in the volume of traffic may be looked for when trade again becomes normal.

In order to avoid the present costly and cumbersome methods of handling traffic and the delays and inconvenience incidental to the process of transhipment, it has, for some considerable time, been the aim of the Federated Malay States Railways to obtain an unbroken line of railway across the straits, the original proposal being to cross by means of a bridge, but owing to the war and the consequent high price of steelwork, the impossibility of obtaining it while the war lasted and the uncertainty of delivery afterwards it was finally decided to construct a granite rubble embankment or causeway, a very important factor influencing this decision being the fact that at Pulau Ubin, which is only 16 miles distant by sea, there was a quarry in existence which contained more than sufficient stone suitable for the work.

In view of the great advantage to be obtained by linking up. Singapore island and the mainland by road as well as by rail it was arranged between the various governments interested that the embankment should be made sufficiently wide to carry a roadway as well as the railway.

The scheme having been favorably reported on by the consulting engineers to the government, Messrs. Coode, Fitzmaurice, Wilson & Mitchell, after careful investigation of the site and the data available as to tides and currents in the locality and other matters affecting the work, the contract for the construction of the works was secured by Messrs. Topham, Jones and Railton, Ltd. about June 1919.

Causeway

The causeway crosses on a line slightly oblique to the centre line of the straits, thus affording easy approaches to the railways on each shore.

It runs from Johore Bahru station on the mainland to a point on the Singapore side about 350 feet north-eastwards of the existing railway jetty, a distance of about 3,465 feet from bank to bank, in an average depth of water of 47 feet at low water.

It is 60 feet wide at formation level affording room for a double line of railway on the eastern side and for a 26 feet roadway on the western side of the bank.

The greater portion of the mound forming the causeway consists of granite rubble of all sizes up to five tons, deposited as it comes from the quarry.

On each side of the bank commencing at the level of 15 feet below, and extending to a height of 4 feet above, L.W.O.S.T. a coating 10 feet thick of heavy rubble, of stones ranging in weight from 10 cwts. to 5 tons, is deposited and finished off to a slope of 2 to 1, the upper surface being brought up to form a berm so as to provide against possible displacement of the upper portion of the work through wave action.

Blocks of 6 : 1 concrete are laid at the back of the berm to form a toe for the granite rubble pitching which is laid to a slope of 1½ to 1 on the upper slopes of the causeway.

The roadway consists of a bed of 9 inches of granite rubble closely hand packed on edge on which a 6 inch layer of granite metalling is thoroughly rolled and consolidated. It is protected on the west on sea side by a concrete-in-mass parapet and on the railway side by a wire fence carried on reinforced concrete posts. The roadway is drained by a side drain discharging at intervals through the parapet.

Ten culverts are provided at the Johore end of the causeway, in order to prevent the accumulation of floating refuse in the vicinity of the lock.

These culverts are circular in cross section and are 5 feet in diameter the level of their inverts being L.W.O.S.T. They are formed of 6 : 1 concrete moulded in segments which are toothed into each other both horizontally and vertically. Outfalls are formed at each end of the culverts in the heavy rubble berm and pitched with roughly dressed stones.

Lock

In order to provide a safe passage through the causeway, after its completion, for the vessels using the straits it has been found necessary to construct a lock on the Johore side of the straits, and it may be of interest to refer briefly to the conditions which render the construction of a lock necessary.

Careful observations of the tides and currents in the Johore straits and around Singapore island indicate that, as on the completion of the causeway the straits will be divided into two estuaries each filling and emptying on the rising and falling tides through its own entrance, not only will differences be found between the levels of the water on either side of the causeway but at one period of the tide the water may be higher on the east side and at another period higher on the west side.

As a difference of level of say 6 inches would cause a current of about four miles per hour in any open channel through the causeway, which would render navigation risky and at times impossible, a lock through which vessels can be passed is necessary and as the differences of level will oscillate from one side to the other, double sets of gates have to be provided to deal with these conditions.

The Johore side of the straits was chosen for the site of the lock both on account of its affording more suitable approaches than Singapore side, and because it rendered it possible to carry out the work without interfering with the existing ferry arrangements.

The lock is 510 feet in length with a length between the sets of gates of 170 feet, a breadth of 32 feet and a depth of 10 feet on the sills at low water.

These dimensions are based on the size of the largest commercial craft at present using the straits with a moderate increase to allow for future requirements.

The lock inside the gates is widened to 45 feet so that say three tongkangs or a large number of smaller craft could be passed through at one operation.

The north wall of the lock is continued eastwards and westwards for distances of about 330 feet and 270 feet respectively forming the east and west wing walls of the lock, the west wing wall being set back 40 feet from the line of the north wall to permit of vessels lying alongside this wall for discharging or loading without interfering with craft entering or leaving the lock.

The material in front of the wing walls is shown to be dredged to a depth of 12 feet at L.W.O.S.T. out as far as the 2-fathom contour line to give access to the lock.

The wing wall foundations are protected from possible scour or undermining by an apron of granite rubble 2 feet 6 inches in thickness extending for 20 feet in front of the walls. This apron

Johore Causeway: Southern End. Town of Johore Bahru in the Background. The causeway will be opened for traffic on October 1st, 1923 is carried round in front of the lock entrances for the same reason.

The side walls, gate platforms, invert and aprons of the lock are formed of 6 : 1 concrete in mass the side walls being faced with a 12 inch thickness of 4 : 1 concrete deposited simultaneously with the concrete behind it. The wing walls are formed of 7 : 1 concrete-in-mass without 4 : 1 facing. The copings to the walls are 4 : 1 concrete blocks and the surface of the walls, except where machinery pits and manholes, etc., occur, is finished off with granolithic paving.

The material on which practically the whole of the lock and also the west wing wall are founded is soft clay of various descriptions, and bearing piles had to be driven over this area. These consisted of ballow piles about 15 inches diameter driven to a 1 inch set with four blows with a 2-ton hammer falling 4 feet.

Firm clay was encountered in the east wing wall foundations and piling was not necessary over this length.

For the regulation of the water level in the lock, when working the same, a culvert is provided in each side wall of the lock. These are 5 feet high by 3 feet wide and the water is admitted or released by cast-iron sluices with gunmetal faces, worked by hand power. From the culverts, there are on each wall five openings into the lock 2 feet 6 inches by 2 feet in cross section and in addition in each of the recesses, into which the gates swing when opened, 3-12 inch outlets are placed for flushing purposes to remove any deposit of silt which might occur and cause trouble.

The lock gates are built of steel and are 24 feet in height 20 feet long and 3 feet 6 inches wide at the centre, the outer skin plates being curved to a radius of 22 feet.

They are subdivided into seven decks with the usual diaphragms and stiffeners. The heel posts, mitre posts and sills are greenheart of the best quality procurable, carefully dressed to dead accurate lines so as to make a perfectly water-tight joint with the granite quoins against which they fit.

Each gate leaf rests on a cast steel pivot sunk into the granite heel post stone and is secured at the top by a "U" bolt passing round the upper pivot and secured to the anchor quoin by adjustable connections. The anchor quoins are in turn fastened in the wall by 3 inch dia. anchor ties passing through the wall into the anchorage pits where they are secured with large nuts and washers.

The lock gates are operated by hand worked capstans, being opened and closed by means of a steel joist hinged to the gate and to which a cast steel rack is fastened. This beam is moved inwards or outwards by a pinion driven through suitable level gearing from the capstan, the gate being easily opened or closed in two minutes by from four to six men.

A clutch is provided for disconnecting the capstans from the gate machinery so that they may be used for warping vessels through the lock.

At each entrance to the lock a chain defence has been placed to prevent vessel entering the lock until the gates have been opened for their reception. These consist of a main chain of $1\frac{1}{4}$ inch stud link chain stretched across the entrance, to each end of which about 40 feet of $\frac{5}{8}$ inch short link chain is attached. The chains pass through cast iron hawse pipes built into the walls, then through a stopper block, and are led to electric winches one on each wall. The stopper block secures the $1\frac{1}{4}$ inch stud link chain in the required position for closing the entrance, depending on the height of the tide, and is opened or closed by a hand lever. When a vessel is to be admitted to the lock the stopper block is opened and the chain allowed to run out until it rests on the floor of the lock.

The usual equipment of bollards, fairleads, boatsteps and adders is provided along the lock and wing walls where necessary.

By arrangement with the municipality of Singapore a subway is provided under the lock near its western end to take the water mains which will be laid at some future date to supplement the water supply of Singapore from reservoirs in Johore.

The subway is 11 feet 6 inches wide by 8 feet high both roof and floor being arched and the vertical shafts being 11 feet 6 inches by 10 feet.

It is formed of 6 : 1 concrete-in-mass with an inside lining of 4 : 1 concrete 12 inches thick and 18 inches thick on the arch, a lining of 1 inch of Syssel asphalt being laid on the 6 : 1 concrete in three layers before applying the 4 : 1 concrete lining.

The shafts are provided with steel ladders and are covered with chequer plate covers carried on steel joists of sufficient strength to carry ordinary wheeled traffic.

The railway and roadway are carried over the lock by a rolling lift bridge 57 feet wide with a clear span of 32 feet feet, the weight of the moving portion of the bridge being 570 tons.

As this type of bridge is new to this part of the world a few particulars as to its design and method of working may be of interest.

In rolling lift bridge the structure, instead of moving on trunnions or a pivot, as in bascule or ordinary swing bridges, rolls backwards and in so doing lifts upwards, the advantages claimed for this type being that no pit is required for the counter-weight and rear portion of the bridge when the bridge is raised, and that owing to the rolling back of the bridge, a shorter length of girder is required to span the opening than would otherwise be required.

The bridge consists of three main plate girders carrying the roadway and railway portion 38 feet long and 5 feet deep carrying cross girders spaced 7 feet apart to which are attached the longitudinal rail bearers and floor troughing.

At the rear end of the main girders segmental girders curved to a radius of 14 feet $1\frac{1}{2}$ inches are connected which carry the ballast box 9 feet by 7 feet 6 inches extending the full width of the bridge and filled with concrete and pig iron in the proportions required for the correct balancing of the bridge, the whole structure being additionally braced by portal girders.

The segmental girders rest on massive level track girders which are carried on beam grillages anchored into the solid concrete of the lock wall and the whole concreted up to the level of the track girders. The length of roll of the bridge is 20 feet the track plates of both the rolling segments and the track girders being accurately machined to provide smooth rolling surfaces. The track plates have projections 6 inches by 3 inches by 2 inches high which engage with slots in the segmental girders to prevent any motion of the bridge apart from the rolling motion.

In order that the bridge may be in equilibrium in all positiens between the "open" and "closed" positions the centre of gravity of the whole structure must coincide with a line passing through the centres of the arcs of the rolling segments. The balancing of the bridge has therefore to be very carefully calculated and carried out. The final balancing is done by trial and error.

The bridge is operated electrically by a 35 h.p. motor carried on the bridge itself the power being transmitted through gearing to the operating pinions at the centres of the rolling segments at each side of the bridge.

These pinions engage in two cast steel spur racks bolted to girders carried on trestles bolted to the bridge abutment, having a length equal to the roll of the bridge 20 feet this being the travel of the pinion necessary to open the bridge to the full extent.

Hand gear is provided for use in the event of a failure in the supply of current.

It is estimated that, against a fresh breeze, $3\frac{1}{2}$ minutes will be required to open the bridge by power and 19 minutes by four men.

The motor is fitted with a powerful solenoid brake which can be released when hand power is used for operating.

The bridge is provided with two nose lock bolts, one at either side of bridge. These bolts will be opearted by a suitable hand gear situated in the control cabin. On either side of the bridge at the nose end an adjustable pneumatic buffer is placed to absorb any shock when the bridge is closing and to assist in bringing the bridge slowly to rest on the bearing blocks in its final portion. At the nose end of the bridge the bearing blocks will be provided with guide flanges designed to ensure the bridge aligning itself properly when closing. The railway track rails are also provided at this point with a similar arrangement with finer limits for adjusting the line of rails on the bridge with the permanent way.

The control of the bridge electrically will be of a semi-automatic nature. The speed operation will be under the control of the operator and will be entirely dependent on him up to the point where rheostatic braking is automatically applied. The railway signals, level corssing gates, nose locking bolts, and operating machinery will be interlocked so that they can be actuated in proper sequence. Limit switches will be fitted to control the rheostatic braking and supply of current to operating motor. An indicator controlled by tappet switches will be provided in the control cabin showing five positions of the bridge. These will be 1 inch closed, 2, 3, and 4 intermediate, and 5 "open." The operations of opening and closing the bridge would be performed as follows :—

1. The signals must be at "Danger" in which position the level crossing gates may be closed.

2. When the level crossing gates are closed the signals are locked at "Danger" and the nose locking bolt gear free to operate.
3. The nose lock bolts are withdrawn. This locks the level crossing gates in the closed position and allows current to pass to the bridge operating gear controler.
4. The bridge is opened by the operator, its position being shown by the successive steps on the bridge indicator. At a position decided on a limit switch is actuated. This automatically introduces the rheostatic brakings, independently of the operator, and gradually reduces the speed of the bridge, so that it approaches the end of its travel slowly, and is finally brought to rest by the last limit switch cutting off the current, and applying the solenoid brake.
5. The bridge is closed by the operator in a similar manner. Its position being shown on the bridge indicator, the rheostatic braking being introduced and the solenoid brake applied exactly as for opening.
6. When the bridge has been closed. The nose lock bolt is operated, this isolates the main operating gear and unlocks the level crossing gates.
7. The level crossing gates are opened. This prevents the nose bolt from being unlocked and releases the signals.
8. When the signals show that the line is "clear" the level crossing gates are locked in the open position and the whole sequence of operations therefore isolated until the signals are again returned to "Danger."

Construction of Works

Causeway.—The contractors Messrs. Topham, Jones and Railton, Ltd. commenced work in Johore and at Pulau Ubin quarry in the latter part of 1919 and the depositing of stone in the causeway was commenced in March 1920.

Owing to delay in the delivery of plant from England and the large amount of work entailed in the opening up of the quarry progress was somewhat slow at the commencement.

In order to obtain railway communication across the straits as early as possible, the construction of the roadway portion was first put in hand and work has been concentrated on this portion up to the present. As soon as this half width bank is completed a temporary single track will be laid over which traffic will be conducted until the remainder of the bank is completed and the permanent rails laid, after which the traffic will be diverted and the temporary track removed and the roadway. etc., completed.

The reason for this procedure is that if the railway half of the causeway was constructed first the roadway portion would then be cut off from the Pulau Ubin quarry unless the barges were brought through the lock which would cause delay and inconvenience.

The rubble forming the underwater portion of the work is brought up to the level of about 5 feet below L.W.O.S.T. by depositing from hopper barges of the usual type with opening bottoms, These barges, which have a capacity of about 300 tons, are loaded at the quarry jetty, towed up from the quarry by powerful sea-going tugs, moored in the required position by ropes attached to heavy moorings, and then discharged. The depositing of stone in this manner was continued from both ends of the work, an open channel being left for navigation in the middle of the straits.

When the channel had been narrowed down to about 1,000 feet wide the currents had attained a velocity of about five miles per hour and then, in order to prevent scouring away of the bottom, stone was deposited all over the channel but will not be brought up to the height sufficient to interfere with navigation until the lock is opened for traffic.

When the bank had been brought up as high as possible by depositing as described, short lengths, sufficient to permit of the erection of a derrick crane, were built up by a floating crane.

These derrick cranes then proceeded to build the superstructure outwards stone being brought to them by lighter barges carrying about 300 tons, and in addition set the toe blocks, culverts and finish off the heavy rubble coating and berm.

In addition to the supply of stone from Pulan Ubin, the 7th mile quarry at Bukit Timah was opened up in the early part of 1922 from which stone is brought by rail in trucks which are run out ahead of the derrick crane on the woodlands end and side tipped into the work.

The chief items of plant employed on the depositing of stone in the causeway are four tugs, ten hopper barges, three lighters, two floating cranes, three steam derricks, one locomotive crane, and one locomotive, in addition to the plant employed at the quarries.

The estimated amount of rubble required to complete the causeway is 1,528,000 cubic yards, the quantity in the half width at present being built being 1,050,000 cubic yards, of which up to the end of October 1922, 842,223 cubic yards had been deposited.

The average amount deposited per month during the year 1922, when the quarries had attained their full output was 46,300 cubic yards, the maximum month's work being 55,000 cubic yards an output which reflects great credit upon the organization and equipment provided by the Contractors.

Lock.—The construction of the lock was commenced towards the end of the year 1919 the north wall, situated as it was on ground above water level, being the first portion of the work to be undertaken.

The construction of the lock necessitated the removal of the railway landing stage and covered way to the station to a site clear of the works.

A new stage and covered way was erected and traffic was diverted in August 1920.

While the north wall and east wing wall were in progress the remainder of the sit of the lock was enclosed by a watertight cofferdam and the construction of the south wall was commenced.

All the walls were built in timbered trenches in lengths of generally 60 feet, the concrete deposited in one length being solidly keyed into the lengths previously built. Generally speaking, little trouble was experienced in keeping the trenches dry, the chief difficulty encountered was the presence in the ground of a large amount of old timber in the upper layers of the excavation, the greater part of the work being on the site of an old sawmill. Logs of all sizes up to 3 feet diameter were found in the trenches, causing trouble not only in driving piles for the cofferdam and trenches, but they had to be cut through or removed when excavating for the walls, and as the majority were in good preservation (a sample is exhibited for inspection) this was a matter of some difficulty.

The trenches for the subway portion of the lock walls were about 45 feet necessitating extra heavy timbering and in spite of this a certain amount of movement occurred in these trenches due to the soft nature of the ground and the great depth. This was successfully checked by additional timbering and excavating to the final level and concreting the bottom in short lengths.

On the completon of the north and south walls the material between the walls was excavated to about 5 feet below L.W.O.S.T. in the open, and the gate platforms, invert and floor of the lock were completed in short cross trenches.

As soon as the gate platforms and granite sills were completed the erection of the gates was put in hand. On the completion of the gates and the dressing of the granite quoins and sills, the gates, which had been erected a few feet away from their final positions, were jacked into place, lowered on to their pivots and anchored in position.

All the excavated material was removed from the trenches and site of the lock by five-ton derrick cranes which were also employed for the depositing of concrete in the walls, etc.

All concrete was machine mixed being deposited in 1 cubic yard skips with opening bottoms which were run from the mixer to the crane by petrol locomotives.

The total quantity of excavation removed exclusive of dredging is 52,000 cubic yards, and concrete in the lock and wing walls amounts to 36,000 cubic yards.

When the lock with the gates and other works had been completed to the full extent possible within the cofferdam, water was admitted to the lock and the removal of the cofferdam and dredging of the entrances was put in hand.

The dredging is done by grabs operated by 2-10-ton floating cranes the excavated material being removed in hopper barges and deposited in deep water about 1½ miles from the works.

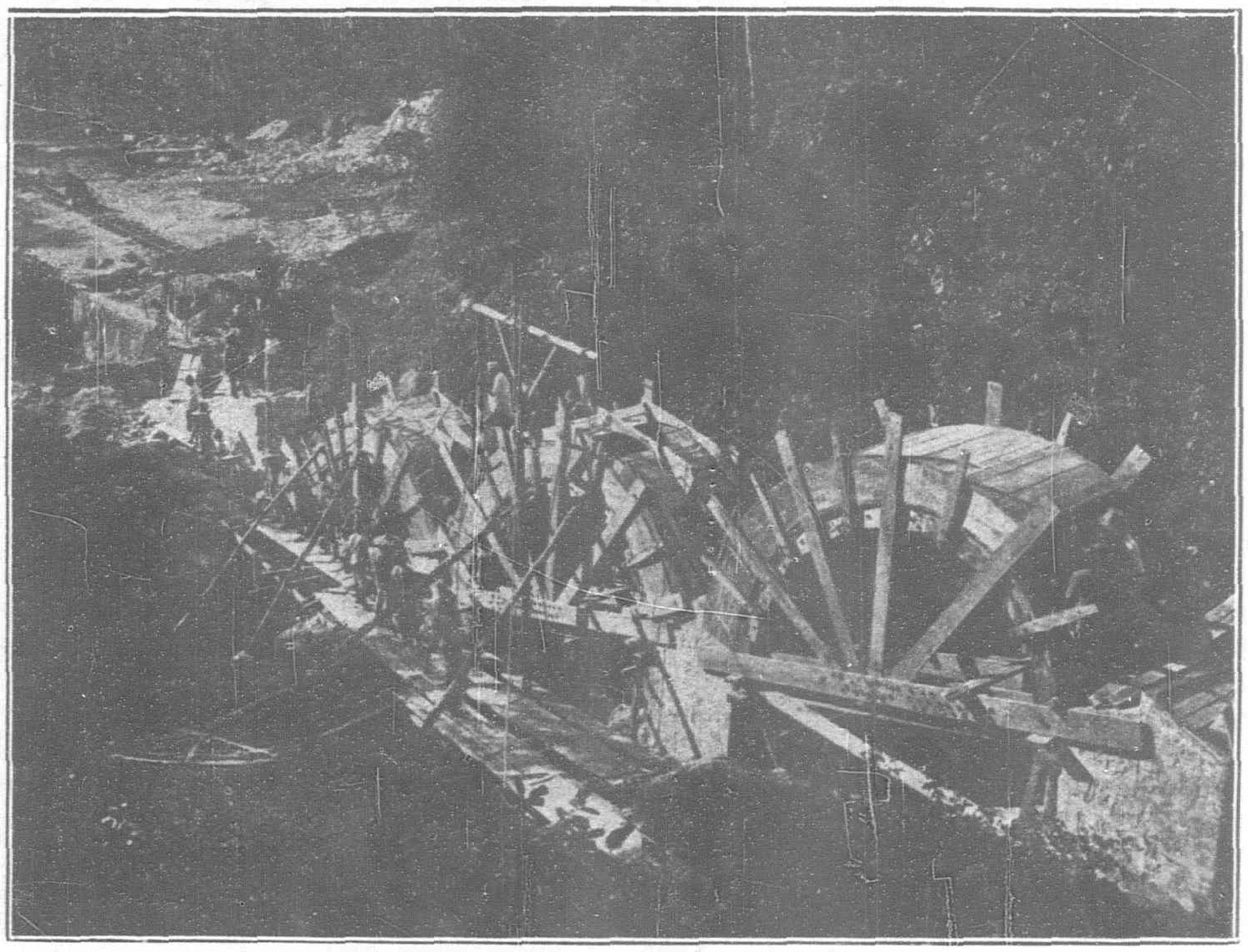
In conclusion the author desires to express his thanks to Mr. James Brown, the chief superintendent engineer, Prai River wharves and Johore causeway, for the preparation of the large scale drawings illustrating the works.

Penang's Hill Railway

By A. R. Johnson, Assoc. M.I. Mech. E.

THE conditions governing the lay-out and equipment of a steep cable railway are entirely different from those obtaining in the case of an adhesion or rack line. In laying-out the latter, after the general route, ruling gradient and minimum curvature have been decided upon, considerable elasticity is permissible in the detailed location, and the surveyor, in running his trial lines, can go back upon his route and modify it if he finds himself getting into too difficult country. The location of any particular portion of the line is independent of that of any other portion, and tangents, curves, and gradients may be combined and succeed each other in an endless variety of ways.

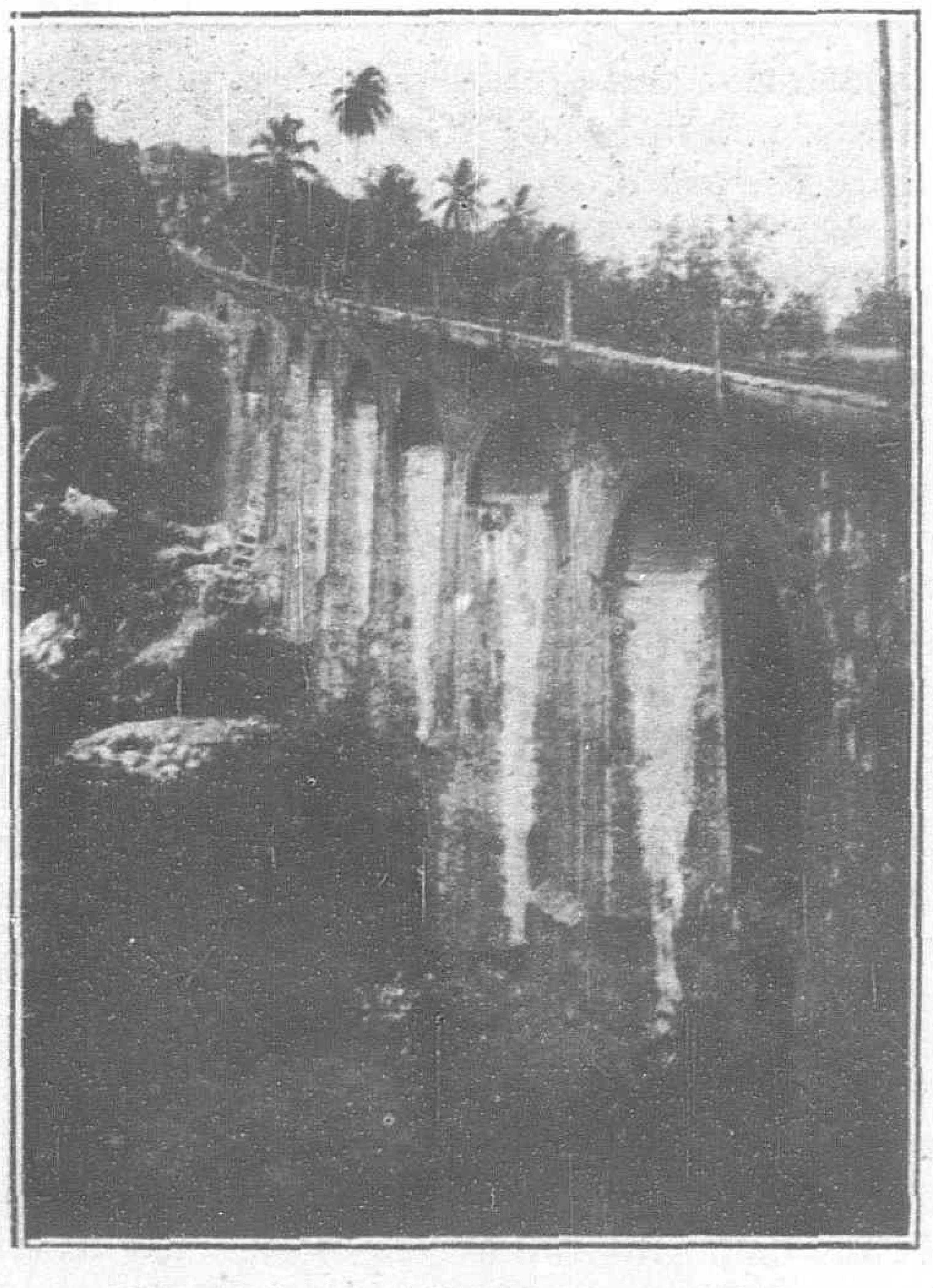
In a well-designed cable line, any portion is not only dependent upon those which immediately proceed and follow it, as in an adhesion line, but upon the whole lay-out from beginning to end; and it is impossible to introduce local deviation either in gradient or planimetric position without affecting the entire location of the line.



Upper Section Viaduct: Under Construction

This stringent condition of design will be clear from the following considerations :—

The cars are not self-propelling but connected by the haulage rope, hence their motion is interdependent. The haulage rope has to be moved as well as the cars, and its weight may be as great as that of the cars themselves.



Upper Section Viaduct Completed

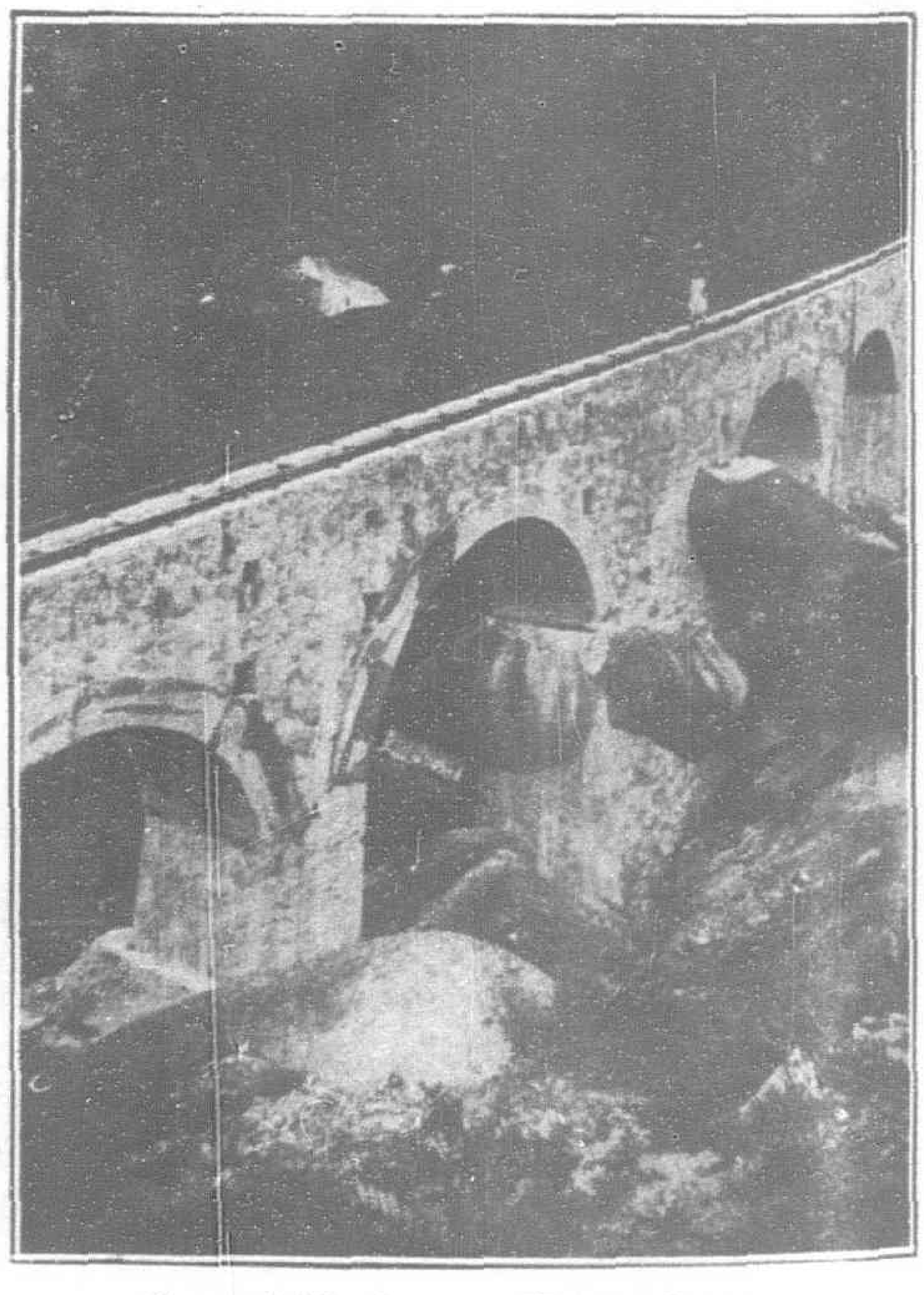
The theoretically correct profile consists of a parabolic curve of which the axis is vertical and of which the variation in gradient is such that the tractive effort to be exerted by the haulage engine is a constant. It is of course advisable to avoid horizontal curvature as in an adhesion line, as far as possible, but the introduction of such curvature even in a marked degree does not involve any serious interference with the theoretical efficiency of the line, if the correct profile is maintained. I do not propose to enter into a detailed investigation of the calculations necessary but to give a general statement of the form of the problem. The arrangement of the cars and the position of the haulage engine on this line are those generally adopted on modern lines of this type.

The haulage engine is placed at the top of the line, and there are two cars attached to either end of the haulage rope, which is led up the line from one car, over the drums of the engine and thence down the line to the other car. In this case the line is divided into two separate and independent sections, but as they are both identical in principle, I will consider only one section.

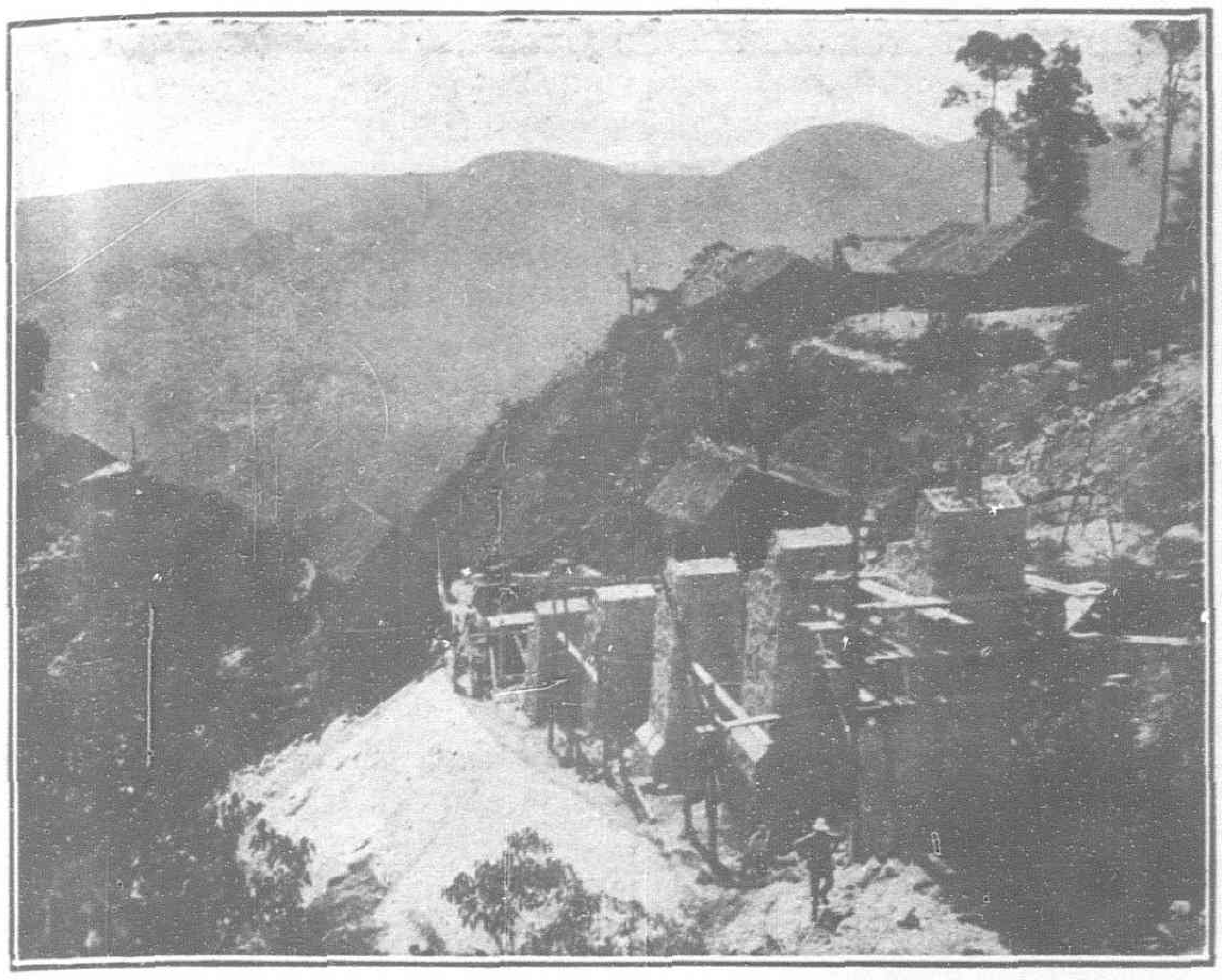
In the figure, let us call the ascending car A, and the descending car B. The cars pass each other at the middle point of the line C. Let us assume that the system is in motion. If the motion is uniform there must be equilibrium between the forces producing it and those which retard it.

The forces producing motion are firstly, the tractive effort of the engine, and, secondly, the components of the weights of the descending car B and the portion of the rope between B and the top acting in the plane of the line. The forces retarding motion are firstly the components of the weights of the ascending car A and the portion of the rope between A and the top acting in the plane of the line, and, secondly, the frictional resistances of the whole system to motion.

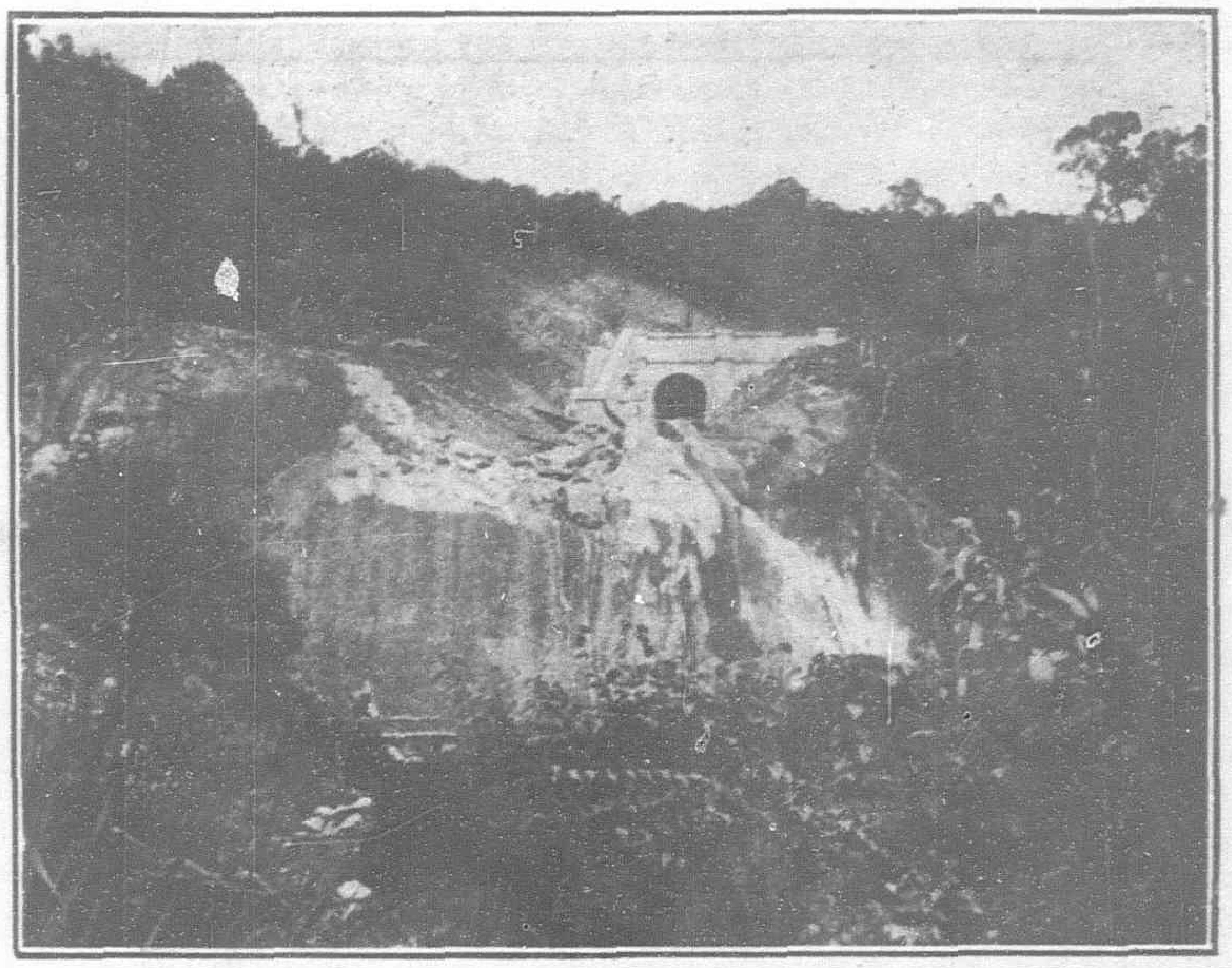
It is clear that, with the cars in the position shown, the engine has to haul up the rope to which car A is attached in addition to the car, and that as the car ascends this load continually decreases. The portion of the rope attached to car B is similarly continually increasing.



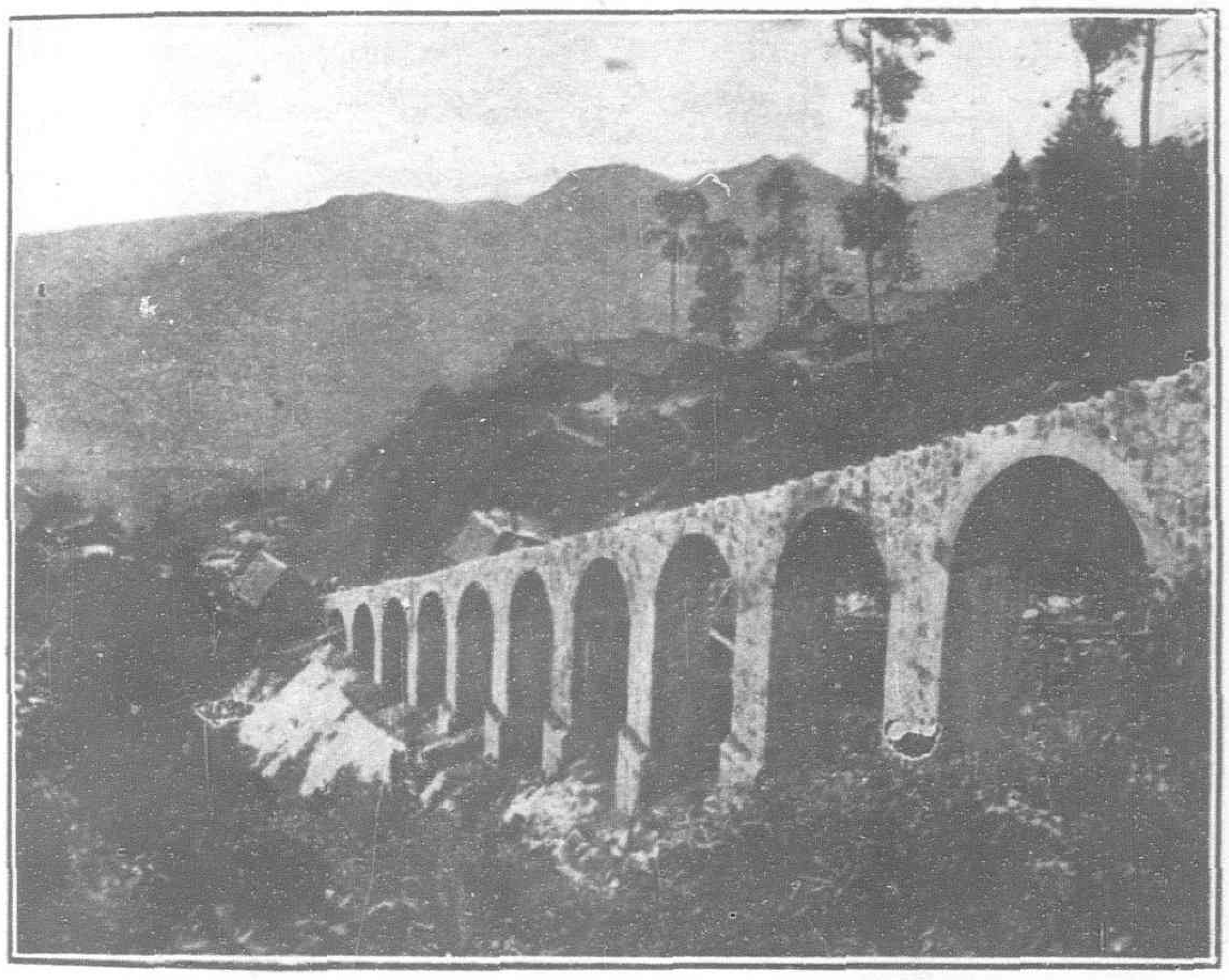
Second Viaduct on Upper Section, height, 1,340 feet



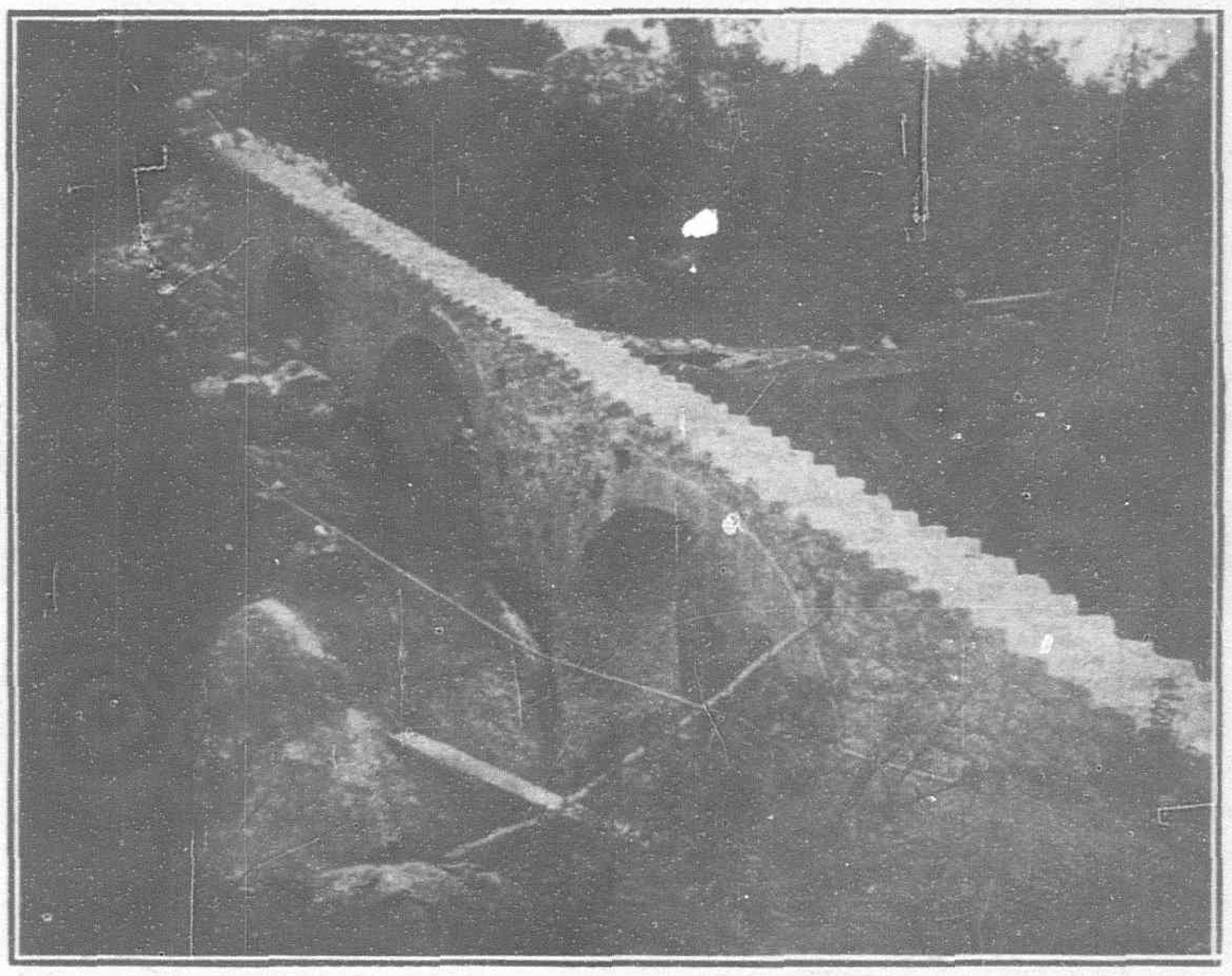
Fourth Viaduct on Upper Section under construction; height 1,880 feet above sea level



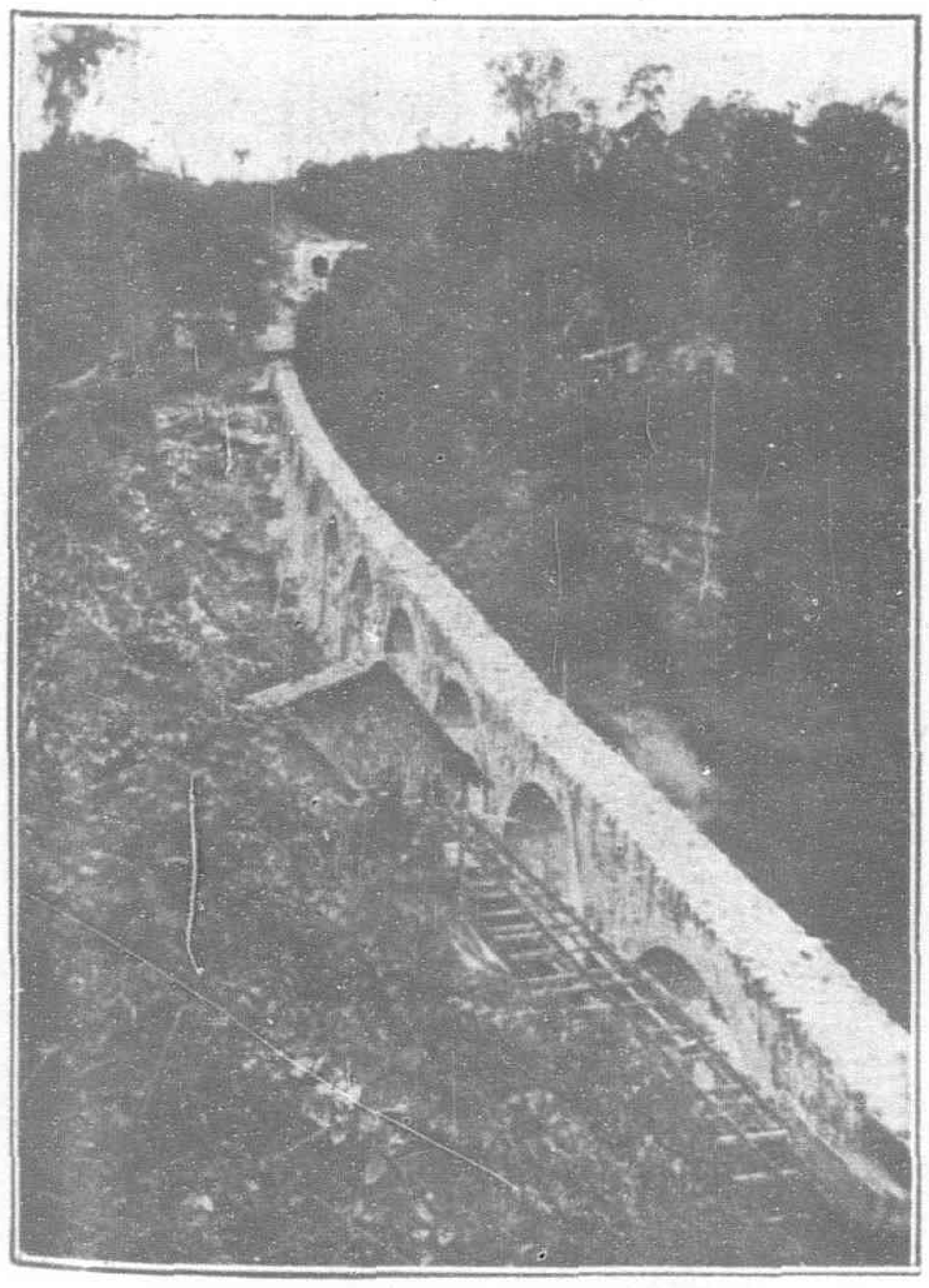
Upper Section lower face of tunnel



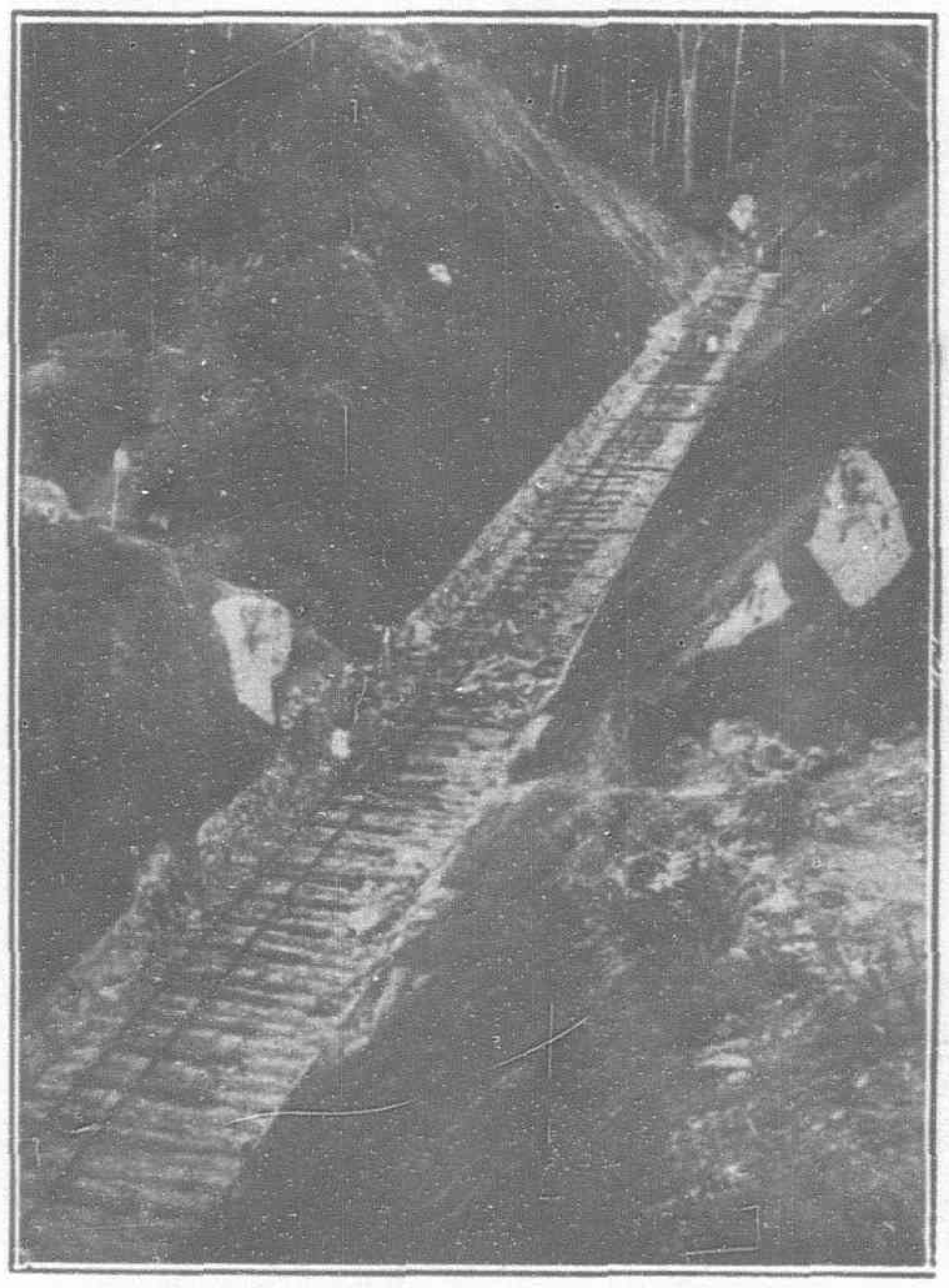
Upper Section Viaduct, looking down; ready for rails.



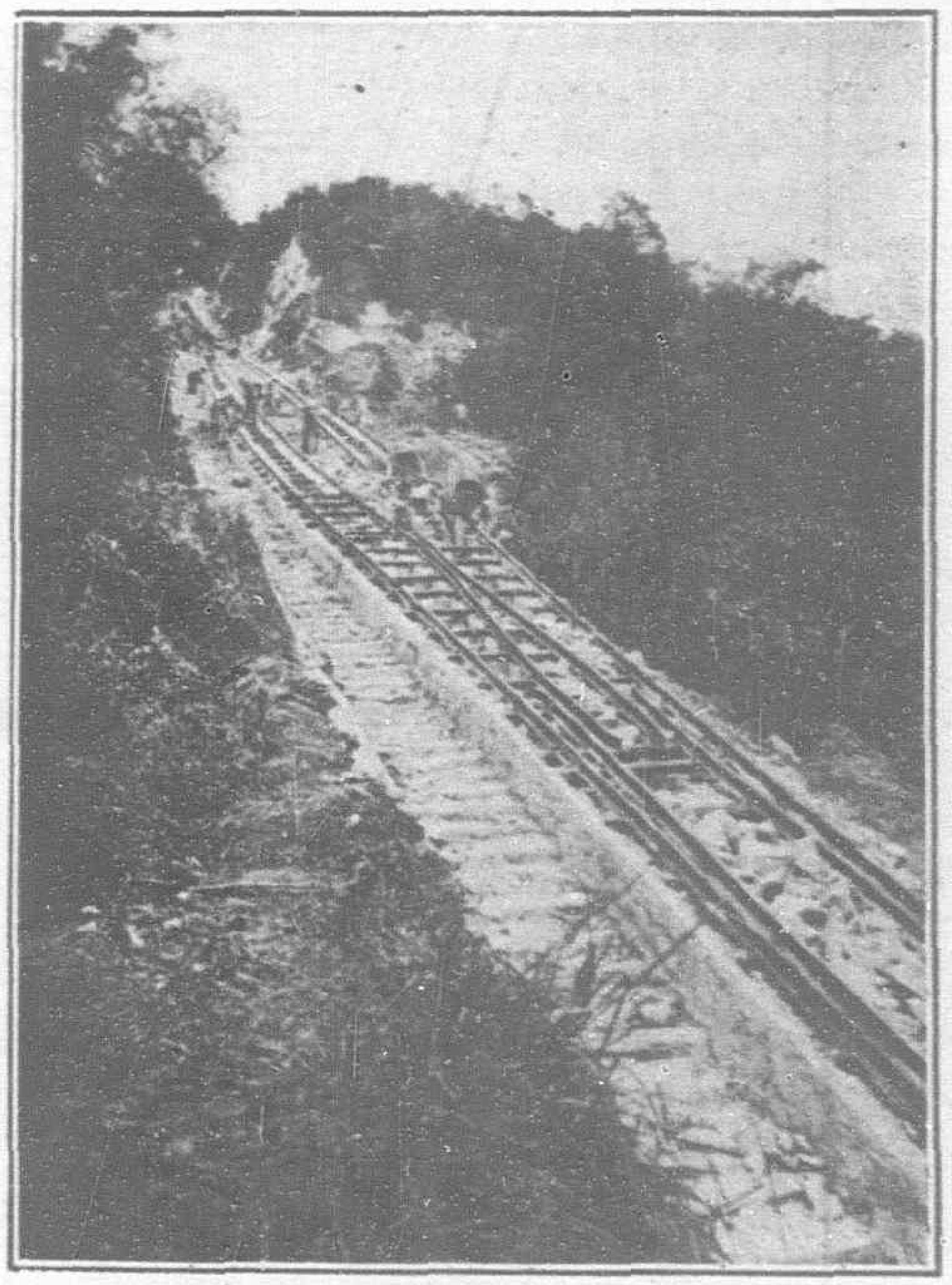
Upper Section Viaduct ready for Rails.



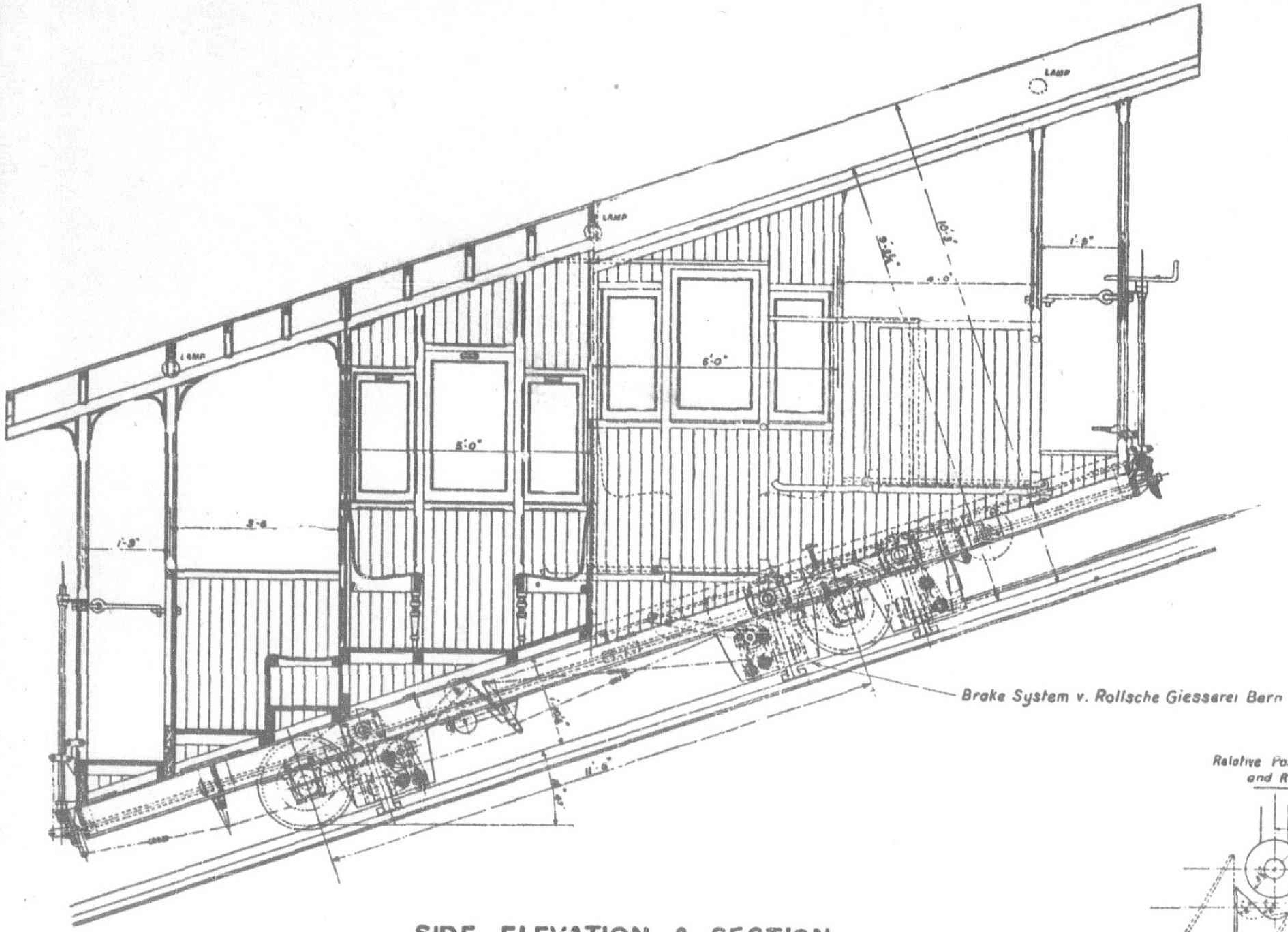
Upper Viaduct ready for rails.



Cutting Upper Section Crossing of Moniot's Road; height, 1,720 feet

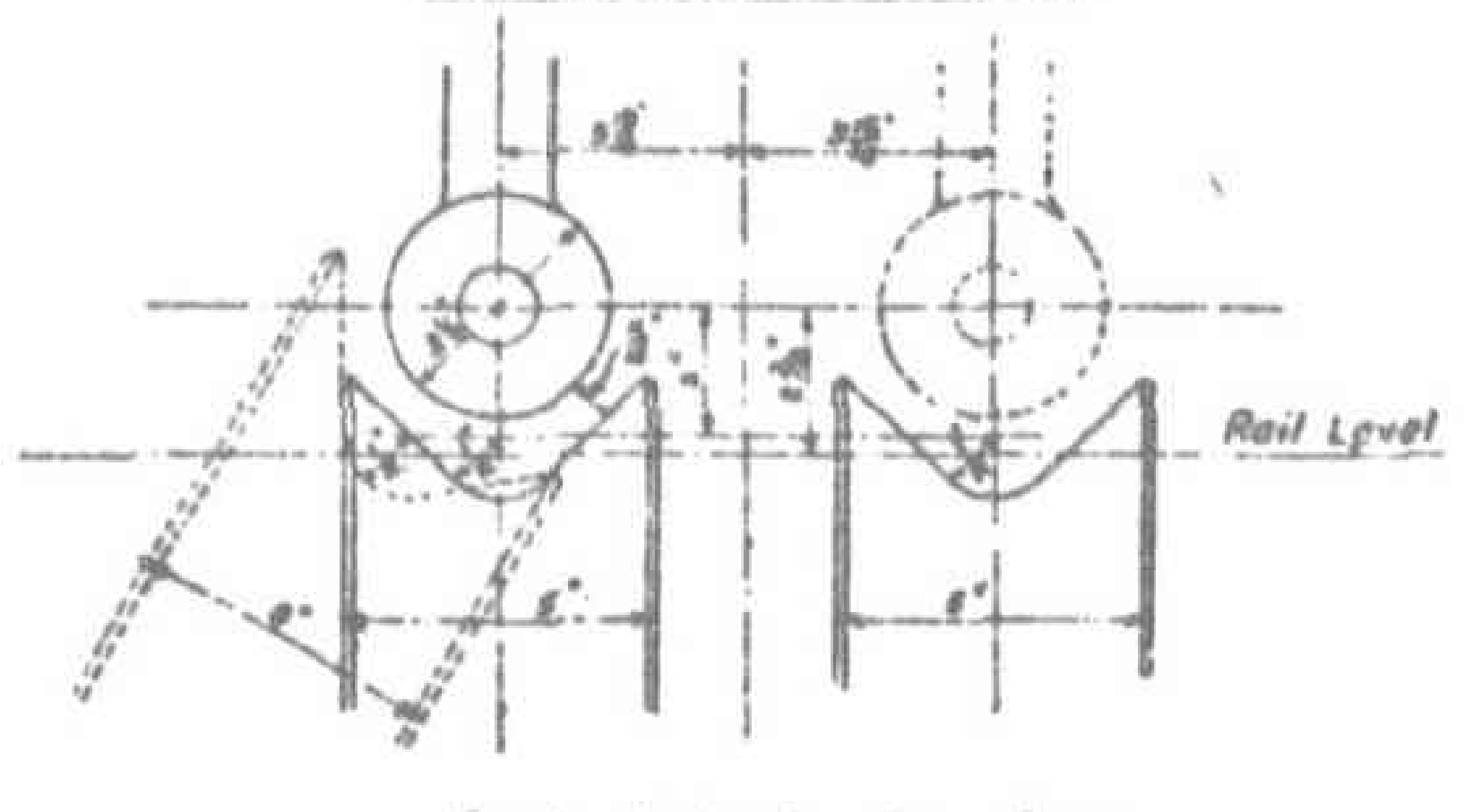


Lower Section Crossing Place; height 556

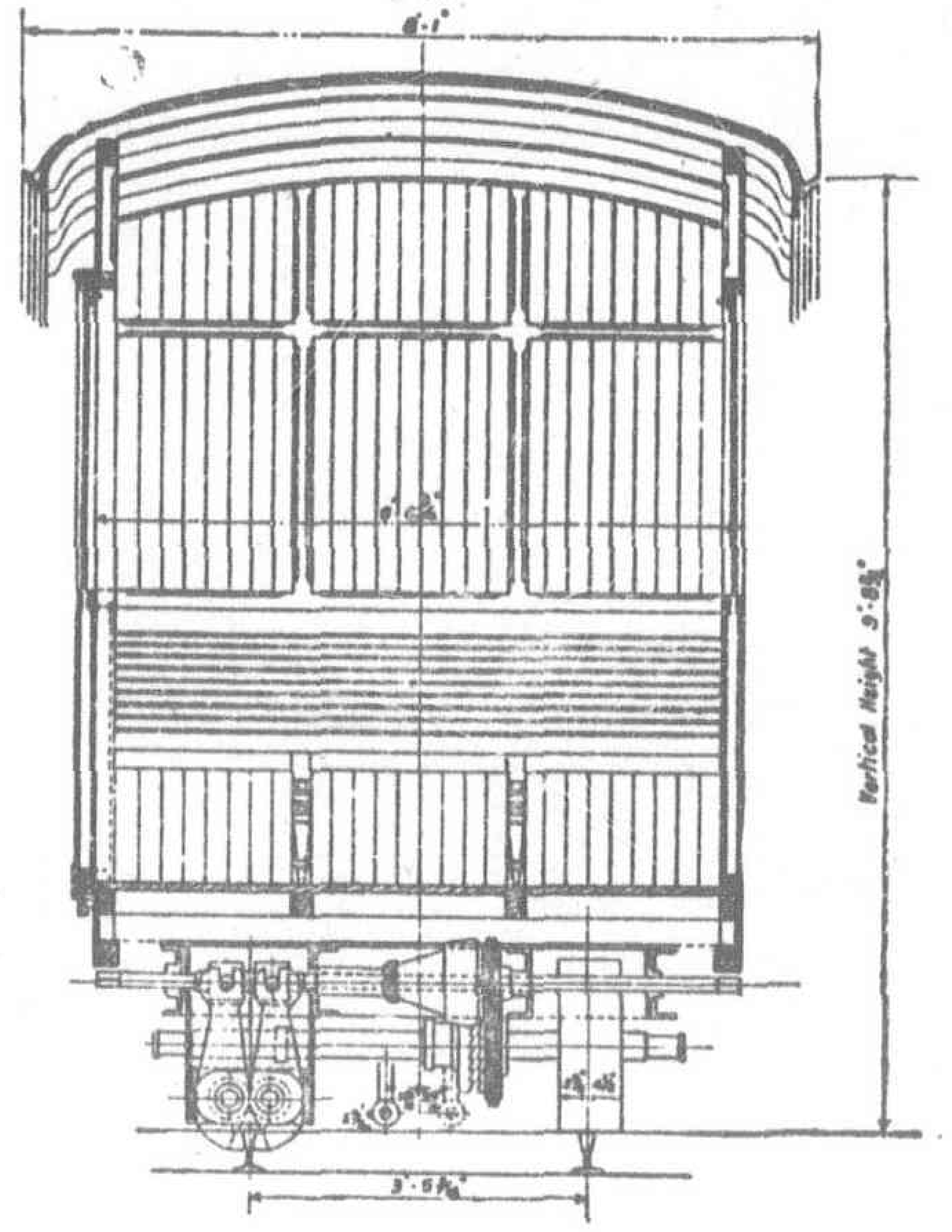


SIDE ELEVATION & SECTION

Relative Positions of Hauling Shackle and Rope Carrying Pulleys

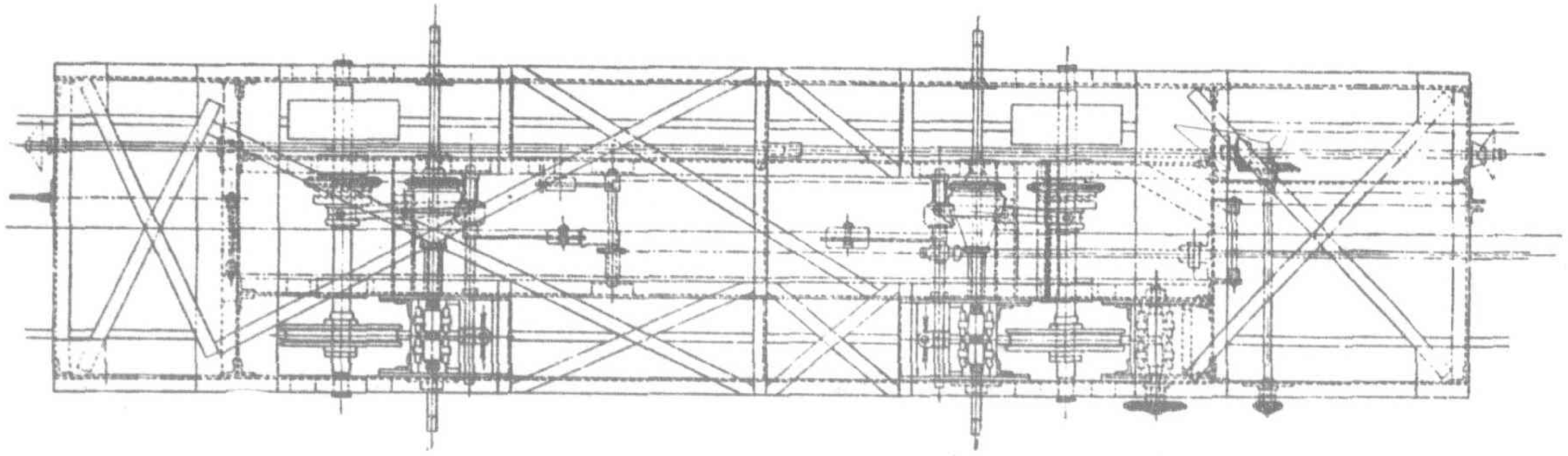


Scale 3 Inches to a Foot.



CROSS SECTION

Scale ¼ Inch to a Foot.

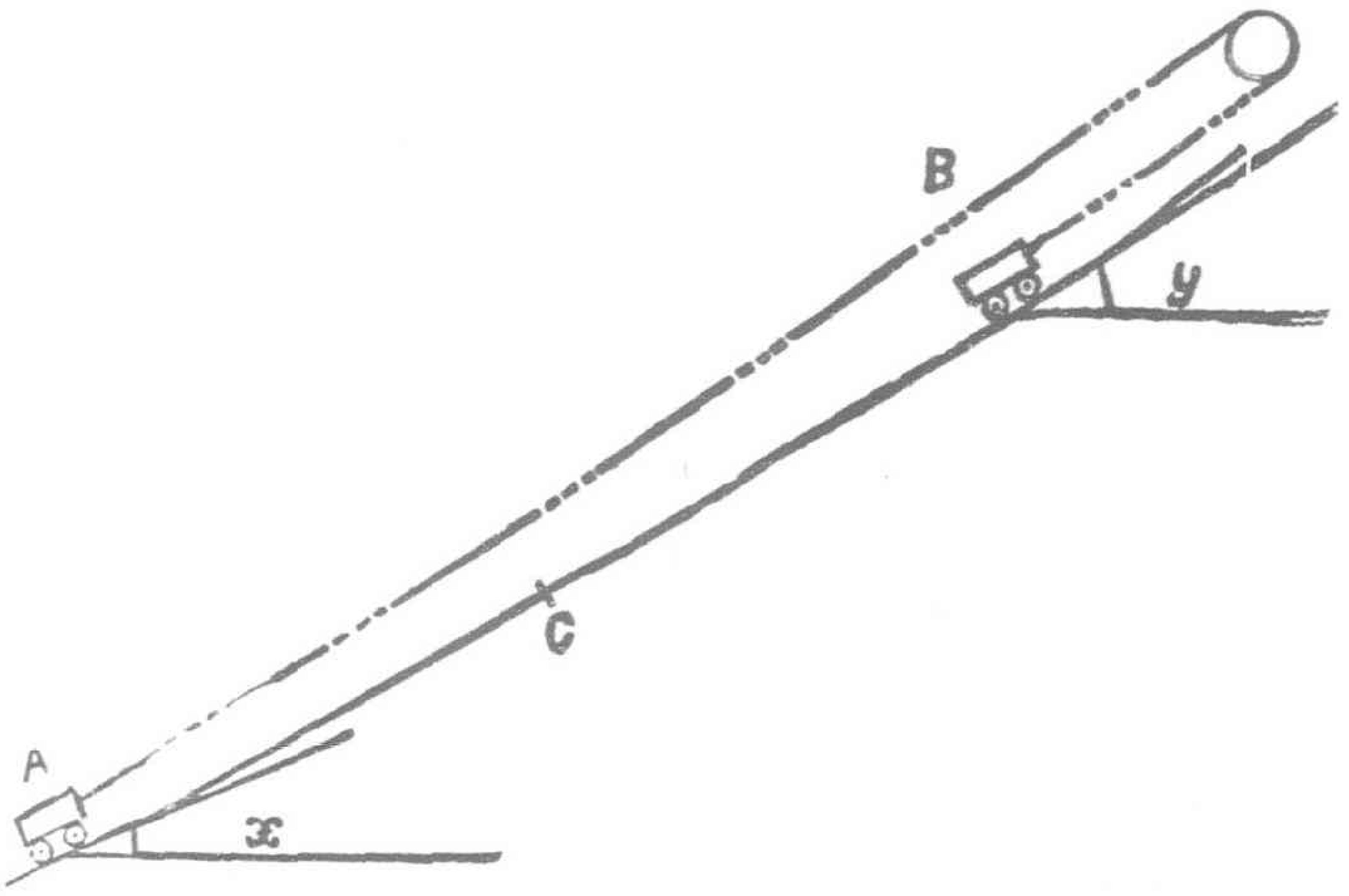


PLAN OF UNDERFRAME

When the ascending car A is below the middle point C of the line, the weight of the rope between the positions of the cars at any moment is acting against the engine, as the two ends above the upper car are equal in length and mutually balance. When the ascending cars has passed the middle point C, the descending rope is the longer and the weight of the difference in length is assisting the engine.

When the cars cross at the middle point C, the load due to the weight of the rope vanishes as both ends are the same length.

From this it is clear that if we could have a weightless rope, in order that the tractive force might be a constant, the profile would be a straight line, that is a uniform gradient throughout, and the tractive force exerted by the engine would be the difference in the components of the car weights acting parallel to the gradient plus the resistances of the system.



But as a weightless rope is impossible, in order to keep the tractive force constant, it is necessary so to design the profile that the difference in the load components at any pair of given car positions varies in a certain ratio dependent upon the varying ratio between the rope ends.

The general condition of equilibrium to be fulfilled may be expressed in algebraical form as follows :—

If A be the weight of the ascending car.
B be the weight of the descending car.
x the angle made by the tangent of the profile to the horizontal at car A and,
y that at car B.
p the weight per unit length of the rope.
H the difference in height between the cars.
R the total resistance to motion of the system
and T the tractive force to be exerted by the engine.

Then $A \text{ Sin } x - B \text{ Sin } y + pH + P = T$.

The term R is so small in a well-laid line and its variation so inconsiderable that although it is not a constant, it is legitimate to take it as such.

The terms A Sin x and B Sin y are the components of the car weights acting parallel to the line, and producing the pull on the rope.

The term pH, although not obvious at first sight, can be shewn to be equal to the summation of the weight components of unit lengths of the rope acting in the plane of the line, and is positive or negative according as it is assisting the engine or tending to retard it. From this equation it is clear that any variation in the weights of the cars A and B or of the rope p produces variation in x, y, and H, and that any variation in only one value affects the value of T, and hence that as T is to remain constant and A, B and p are fixed values for any proposed profile x and y must vary in a definite ratio.

Hence any alteration in the tare weight of the cars, in the loading of either of them, or in the weight of the rope produces an alteration in the theoretically correct profile for any given values of these elements. Having fixed their values, from an analysis of equations similar to the one I have given, it is possible to obtain a parabolic equation for the profile which will give a constant load on the engine, and this is what is to be aimed at in the design. As, however, the relative values of A and B may vary with every trip, according to the number of passengers ascending or descending, it is necessary to assume values which will make T a maximum, and this condition obtains when the ascending car A is full and the descending car B is empty.

It might appear that it would be advantageous to use the lightest possible rope consistent with its not rising out of its carrying pulleys at any point when under its maximum tension, but this is not necessarily the case, as the difference between the values of A and B and x and y may be such that when A is nearing the summit of the line, the component of its weight pulling on the rope is so great that the component of B plus the component of the descending rope is not sufficient to prevent the tractive force continually rising in value. This is the case in this line and it has been necessary to use a rope of a size and weight considerably in excess of those required for safety only, in order to balance the large component pull due to the steepness of the upper part of the profile.

With regard to the resistances which I have grouped under the term R, they are more accurately expressed by the terms $Af \cos x + Bf \cos x + R$ in which f is the co-efficient of rolling resistance per ton of the cars on a level line and R is made up of the resistance to motion of the rope over the carrying pulleys plus the resistance of the rope to bending around curves and over the haulage drums of the engine. None of these components are capable of accurate evaluation as they all depend upon more or less indeterminable factors, such as the lubrication of the car wheel journals, the condition of the rail head, the wear of the wheel treads, the construction and internal condition of the rope, etc.

They may be calculated by analysis, if certain assumptions to cover the unknowns are made, and when this has been done an outside figure is taken to cover them all. Their total value is only a small percentage of the total tractive effort of the engine, probably about 10 per cent. As the speed of the cars is low and their weight comparatively small, very slight variation is produced in the rolling resistance during the periods of acceleration and retardation.

Further as about the same number of carrying pulleys are being rotated at any time during a trip, there is practically no variation in their total resistance at any moment. The resistance due to the bending of the rope is not dependent upon its velocity and hence is invariable when the system is in motion. From this it will be seen that it is quite legitimate to take the resistances under uniform motion as a constant.

With regard to the question of acceleration the speed of the cars being low, 5.25-ft per second on the upper and 4.28-ft per second on the lower section, it can be obtained in a very short distance, and an acceleration of one-tenth of the full speed per second has been adopted. The engine during acceleration has to impart the maximum momentum to the whole system, and the weights of all parts being known its value can be obtained. As it is theoretically possible to start infinity slowly the load on the motor need not rise above the maximum, but as this is not practicable the starting gradient has been eased to permit of a reasonable speed of acceleration without the load so rising.

Further points to be considered in the design which are dependent upon the form of the profile, are that the rope will always remain throughout in the treads of the carrying pulleys under the maximum tension to which it may be subjected, and that the distance apart of the pulleys may be such that it does not touch the ground or have too great a sag between them when under its minimum tension. The latter condition may be fulfilled by having the pulleys very close together, but this is not only uneconomical in material, but introduces unnecessary resistances into the system, and the correct distance should be calculated from an investigation of the varying tensions in the rope. As the tension increases continually from the bottom to the top of the line, the pulleys may be fixed at correspondingly increasing distances apart as the gradient increases.

From this general outline of the problem, it will be clear that the location has to be considered as a whole, and that it would be a waste of time to attempt to lay out a trace in the usual way by trial lines run from some selected starting point, without any knowledge of the ground in the front.

The method I adopted was as follows. The most suitable locality for the line had first to be determined. The conditions governing this selection were that the slope of the hill chosen must be a comparatively short one and uninterrupted by isolated summits, that the starting point of the line must be as near as possible to a main road, and that the upper terminus must be at a point easily accessible from the existing roads and buildings on the hill.

These conditions determined the general position. I then made a contour survey of the portion of the hill side which lay within this general area.

Contours were run at 50-ft. intervals and were referred to a base line laid out straight from the bottom to the top. The total length of contours so surveyed were about 24 miles. A large scale contour map was then drawn.

I found the whole slope of the hill extremely broken and uneven. Precipitous faces of rock, some of great height, were common on the upper slopes, while the lower were intersected by numerous gorges filled up with boulders of all shapes and sizes piled on top of each other. Some of the boulders are of enormous size; one which the line crosses on a viaduct, I estimate to weigh over 12,000 tons.

The line passes over several of the gorges, which appear to be in some places of great depth. There is an arch of one of the viaducts thrown over a roughly circular hole, down which I let a hundred feet tape to its full length without touching bottom and I could hear the box knocking against the dry sides of the boulders as it swung from side to side.

I investigated about sixty different locations by means of the contour map. Even slight deviations in planimetric position produced remarkable effects upon the quantities of substructure works. A lateral alteration in position of twenty or thirty feet would change a cutting into a fill and *vice versâ*, almost throughout the whole length of the line, and if a deviation was introduced to avoid an exceptionally heavy work, it inevitably involved the introduction of another above or below it.

Thus location became a question of selecting a route in which the work was as small as possible and horizontal curvature reduced to a minimum at the same time that the profile for given values of car weights and rope was adhered to. If it was found that a particular profile was impossible to get through, these values had to be modified and a profile of another form tried.

When I had brought the best location within narrow limits of deviation, cross sections were taken throughout and the final exact location arrived at by nothing the effect of small deviations thereon.

The line is in two separate and independent sections, both of which have theoretically correct parabolic profiles for the greater portion of their lengths, but as I previously stated, in order to compensate for starting resistances and to adjust the ends to convenient positions, the gradient of the lower portion of each is eased by the introduction of a short circular curve tangent to the parabola. Horizontal curvature had to be introduced on both Sections, that on the lower consisting of a short curve of 1,500-ft. radius at the bottom, and there are two curves on the upper section, the radius of the sharper of the two being also 1,500-ft.

It would have been possible to obtain a location in a single section, but to have approximated to the best conditions, it would have had a great deal of horizontal curvature, very high viaducts and probably several tunnels; it would have been more costly to build, work and maintain, and its carrying capacity would have been less than that of the location adopted.

The total length of the line measured along the formation level is 1 mile 435 yards and the total rise in this distance 2,270-ft. The mean gradient is slightly less than 1 in 3 and the maximum 1 in 1.98 on the lower and 1 in 1.93 on the upper section. The centre of the upper station is 2,381-ft. above mean sea level.

With regard to the details of design and construction, owing to the steep slopes and destructive possibilities of heavy storm water, no attempt has been made to support the formation upon earth fills. The whole line is carried on masonry throughout and no loose stone ballast is used, the track being built into the masonry and anchored by long bolts at suitable intervals. The bottoms of all cuttings are also pitched in step formation throughout.

The track through the cuttings is carried on a raised masonry bed in the middle, leaving a three foot table at each side for storm water and service purposes. The permanent way is specially designed to prevent creep of the rails down-hill, and the latter can be taken up and relaid without removing the sleepers from the masonry. As the sleepers are steel angle irons, their renewal will only be required at very long intervals. The rails are of a special section with a wedge-shaped head, to provide a suitable grip for the car brakes.

Owing to the plentiful supply of granite and the difficulty of transporting and finding suitable working sites for materials or machinery on the slopes, I decided to build all the viaducts in rubble masonry with concrete arches. All sand and cement has to be hauled up from the bottom, but the stone is broken as near to the site as possible. I found an arch of 16-ft. span worked out as the most economical per 100-ft. of viaduct, and this has been adopted throughout, except where the line crosses some very large boulders near the bottom where I am building two forty feet spans. The arches are two centred and of two radii, the smaller radius being on the upper side. Owing to the gradient of the formation and consequently unevenly distributed dead load, better resultant thrusts can be obtained with an arch of this form than with a symmetrical one of any shape, and there is a considerable saving in the amount of backing over the upper haunch. The maximum height of the viaducts is 50-ft. from top of footings.

The line intersects a precipitous spur of the hill near the top of the upper section and as a cutting at this point would have had a maximum depth of about 80-ft. on the centre line and a side slope of about 185-feet, besides removing a huge mass of earth buttressing the Summit of Strawberry Hill, an outlying shoulder on the edge of which the line terminates, I decided to tunnel it.

The tunnel is 258-ft. long on the formation line, and on a gradient of 1 in 2.04.

The lower heading is in fissured rock and is being taken out to nearly full section; at the upper end, as hard red earth was first met with, separate headings for each side wall were driven, and these are being built first before driving the arch heading. Both these upper headings have now struck rock about 50-ft. in, and I anticipate that the remainder of the work between will be in more or less solid rock. Owing to the steep gradient, the design of the tunnel possesses many peculiarities, and special methods of construction have had to be devised.

The cars are each capable of carrying about 40 passengers seated and standing, and as one trip can be run every quarter of an hour, the maximum carrying capacity of the line is about 150 passengers in each direction per hour.

They are built to the mean gradient of the line and are divided into four compartments and two end platforms for the car attendant, all of which are stepped one above the other so that the floors are level. As only a single track is used throughout the line except at the crossing places, where the track is double, a special arrangement has been used whereby the cars automatically pass each other at the centre of the line. Let us assume we are looking up the line from the bottom and as before, call the cars A and B.

Car A is fitted with double flanged wheels on the right-hand side and flangeless wheels on the left. In Car B the double flanged wheels are on the left and the flangeless on the right. At the crossing place the outside rails of each track are uninterrupted throughout and form a continuation of the right and left hand rails of the single track above and below the crossing. The inner rails are interrupted to permit of the passage of rope.

The double flanged wheels of both cars follow the continuous outer rails on either side and the flangeless wheels ride over the breaks in the inner rails. Hence Car A always takes the right hand track and Car B the left hand at the crossing place automatically and without the use of any switches.

Each car is fitted with three emergency brakes, two of which are automatic and each of which is capable of pulling up the car fully loaded on the steepest gradient in a distance of 5 to 6-ft. Each brake consists of a pair of forged jaws which embrace the specially shaped rail head and are normally adjusted with a clearance of $\frac{3}{16}$in. on each side thereof. These jaws are pivoted to an extension of the car frame a short distance above the rail head and are extended upwards in two arms which embrace a pair of heavy right and left hand nuts on a shaft carried in the car frame. The travel of the nuts caused by the rotation of this shaft gradually applies the jaws to each side of the rail head. The shaft is provided with a spur wheel which is thrown into gear with the car wheels by means of a saw tooth clutch. Under normal conditions this clutch is kept open by the tension of the rope, but if this fails from any cause and the car commences to run down the hill, its failure causes the fall of a heavy balance weight. The arm to which the balance weight is attached is fixed on a shaft which carries a cam, the rotation of which on the fall of the weight throws the clutch into gear with the car wheels.

By this arrangement the rolling of the wheels down hill supplies the motive power by which the brakes are applied, and any tendency for the wheels to slide instead of rotate is counteracted by the from of the rail head and jaws, as the latter tend to slide down the faces and hence increase the pressure between the rail surface and wheel treads. A slight deformation of the car frame immediately ensues which materially assists in jamming the car on the track.

Special provision is being made for dealing with goods traffic in loads up to about 2½ tons. Such traffic is quite unusual as a general service in lines of this type; but in this case it is essential to permit of an economical development of the Hill. As it is imperative that the attachment between the rope and the passenger car be of a form to preclude possibility of interference or negligent handling it is made permanent and only capable of detachment under responsible supervision. Hence it is necessary for the passenger cars to be hauled up the line with every load of goods, and as the latter cannot be loaded in the car, a special wagon is provided which when loaded is lifted on to the rails by a crane and placed in front of the car, which propels it up the line. On arrival at the top it is transferred to a siding by another crane and hand shunted to a convenient position for unloading. At each trip the passenger car forms a non-paying dead load, but the design of the line is such and the gradients are so steep that it is absolutely essential to leave no chance of accident from negligence in the fixing of the rope attachment.

The motive power of the line will be electricity which it is proposed to obtain provisionally from the municipal power station in Penang.

The haulage engines are of the Whiting type with three sheave drums of 12-ft. 6-inches in diameter in the treads. The drums will be fitted with Walker differential rings to take up unequal stresses in the rope due to wear in the treads. Such stresses become very great if they are not compensated for, if the grooves wear unevenly after a period of use, and a very slight difference in diameter is quickly appreciable in drums of this size.

The emergency brake is directly attached to the main haulage drum. It consists of a cast steel tread, accurately turned, embraced by a pair of heavy post brakes. It is operated by means of a weight normally held in the "of" position by means of a locking bolt held up against a spring by an electrically energised solenoid. The brake is tripped under any of the following conditions:—

(*a*) When the speed of the drums exceeds 15 per cent. of the normal haulage speed.

(*b*) When the ascending car reaches a pre-determined position at the top of the line.

(*c*) Failure of the current through the tripping of the main circuit breaker either by overload or through cessation of supply.

(*d*) By an emergency hand operated switch on the control platform.

In addition to this brake, each haulage engine will be provided with a mechanical hand brake, an electrical hand brake and an automatic electric brake. The main haulage drums are driven by speed reduction gearing arranged on three motion shafts, the motor being direct coupled to the first.

As the cars are started simultaneously by the driver of the haulage engine, who cannot see any hand signals given by the car men, a special signalling installation is provided, whereby the driver exchanges both bell and visual signals with the stations, and which are so interlocked that he cannot despatch the starting signal until he has received the ready signal from both stations. In the event of the car man requiring to stop on the line through obstruction or other cause, he is provided with a telephone earthed through the car frame and wheels on one side and provided with a contact fork on the other with which he can close the circuit by touching a singal wire arranged in a convenient position throughout the full length of the line. The closing of the circuit rings a larger warning gong in the engine house, on the sounding of which the driver immediately stops the engine.

Hydro-Electric Developments in N.E.I.

(Continued from page 523).

tricity on the island of Java is completed, these power plants will fit properly into the system.

The aforementioned constitute about all the developed hydro-electric plants and those under construction in Java. The government, however, in connection with private enterprise, has ambitious plans for the immediate future which include the installation of 18,600 h.p. in light units at different points in the Tji Mandiri territory; 43,700 h.p. at ten sites on the Tji Sangkoeg; 31,500 h.p. in four units on the Tji Laki; and 30,000 h.p. at seven places in the Tji Manoek territory. In these four districts, which are in the west, there will ultimately be provided 123,900 h.p.—equal to about a quarter of Java's potential development. These stations, as well as projected and well-designed plants in central and eastern Java, will be constructed and utilized primarily for generating power to operate the railways; but it is believed that there will be sufficient energy remaining to supply current for many other uses—industrial and municipal.

Java is justly proud of its railway system and of the fact that it is apparently going to be the first tropical Asiatic country to modernize it by the introduction of electric traction. The local government is proud, too, that it has been able to work out the financial questions in connection with the electrification without the aid of the home government.

The railways of Sumatra, Borneo, and Celebes have not yet assumed an importance which justifies electrification. When they do, however, ample water power awaits them. The power possibilities of south Sumatra are so great that it has been suggested developing some of the sources and transmitting the current to Java under the narrow Strait of Sunda—about eighteen miles wide—which separates these two islands. Sumatra has a considerable number of small hydro-electric plants at work. These vary from several hundred to 3,000 or 4,000 h.p., and are used, largely, to to supply power for mining and agricultural operations.

In regard to the island of Celebes, which is credited with a potential 1,000,000 h.p., it was stated last year that the famous nitrate syndicate had received a concession to develop water power there and that it would shortly erect a 200,000 h.p. plant for the manufacture of fixed nitrogen and metallurgical products.

Conservancy Work in North China

(Continued from page 545).

From the point of view of river regulation it should also be possible to construct retaining reservoirs in the hilly area whence the rivers flow at a comparatively small expense, and these should be of immense value to agriculture from the possibilities of irrigation thus presented.

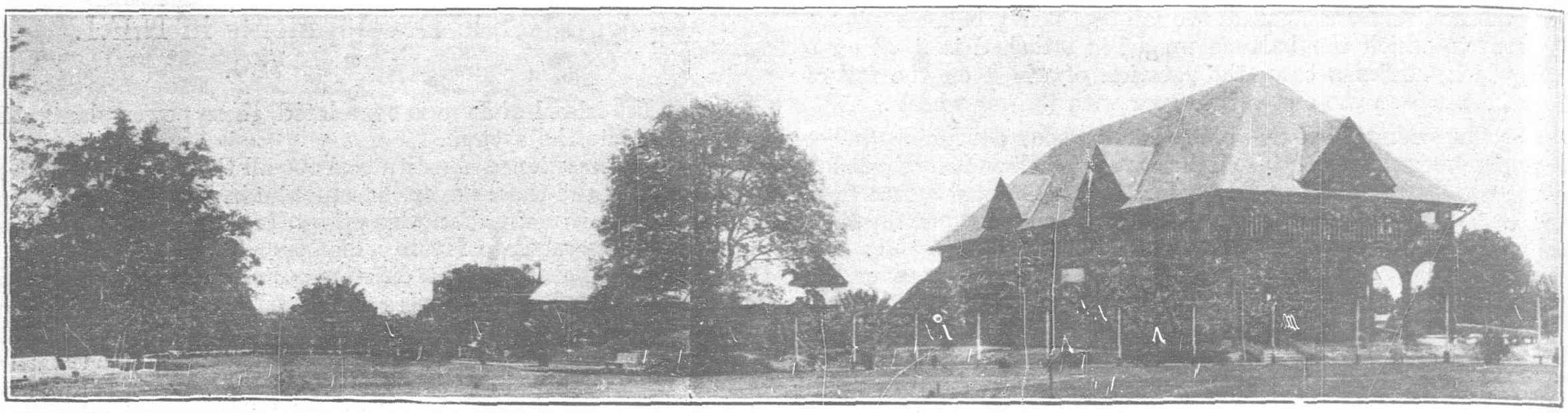
In conclusion, one point which has frequently come under the writer's observation is that which is raised by the difficulty of bridge building in China.

The rivers in this country run at one-tenth of their capacity for six months in the year, but during the rainy season of July-August they rise both in level and velocity with the most surprising rapidity.

It is perhaps natural that engineers who have not been long resident in China should fail to realize this possibility, and therefore neglect to plan their bridges accordingly, but it is inexplicable that the Chinese themselves should persist in the construction of bridges on the pattern of the well-known Marco Polo bridge with its narrow arches, though indeed the capacity of that is far greater than of many others which the writer has seen in different districts.

The new concrete bridge at Yangtsun on the Pei Ho is an example of choking the course of a river which should be a sufficient object lesson to all who have seen it, while the numerous timber bridges built in various localities by the natives themselves are annually destroyed by the pressure of flood water.

This, however, is but a minor point to be noted in passing, and in no way affects the trend of this article, which is intended to point out the vast possibilities latent in China for the development of scientific engineering in all its branches, providing that the government of the country can be stabilised, and a sense of national and public welfare inculcated in the minds of the people.



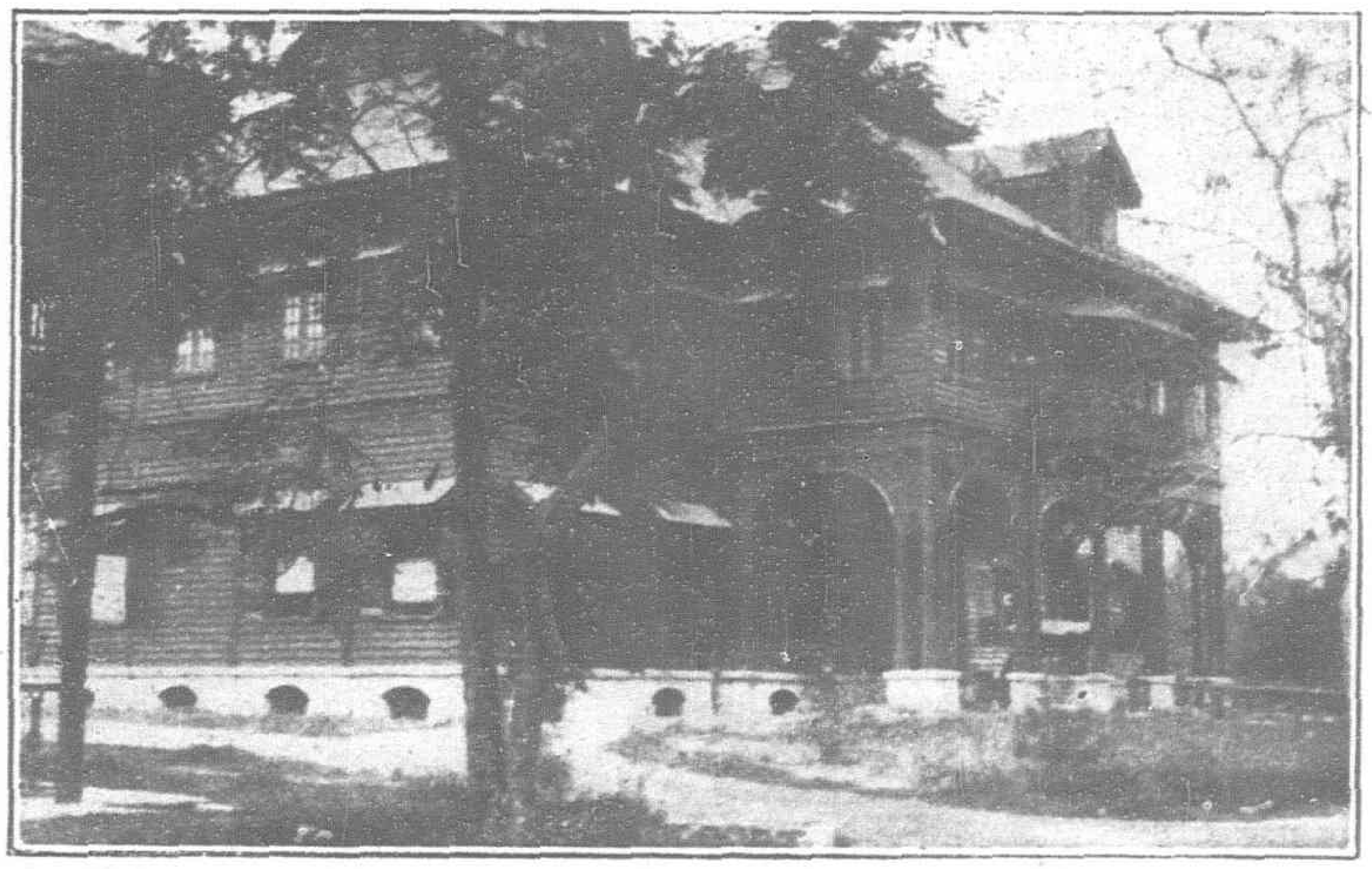
Government House and Grounds, Sandakan

North Borneo

Her Capital and its Relations to the Trade Routes of the Far East

By G. C. Irving

IN previous articles we have dealt with North Borneo as a new country in which some of the excess population of China may find good homes and profitable work, we have discussed the country's economic condition and outlook and have given a general idea of development in the form of railways and roads. This article will be devoted to our principal town and port, that of Sandakan.



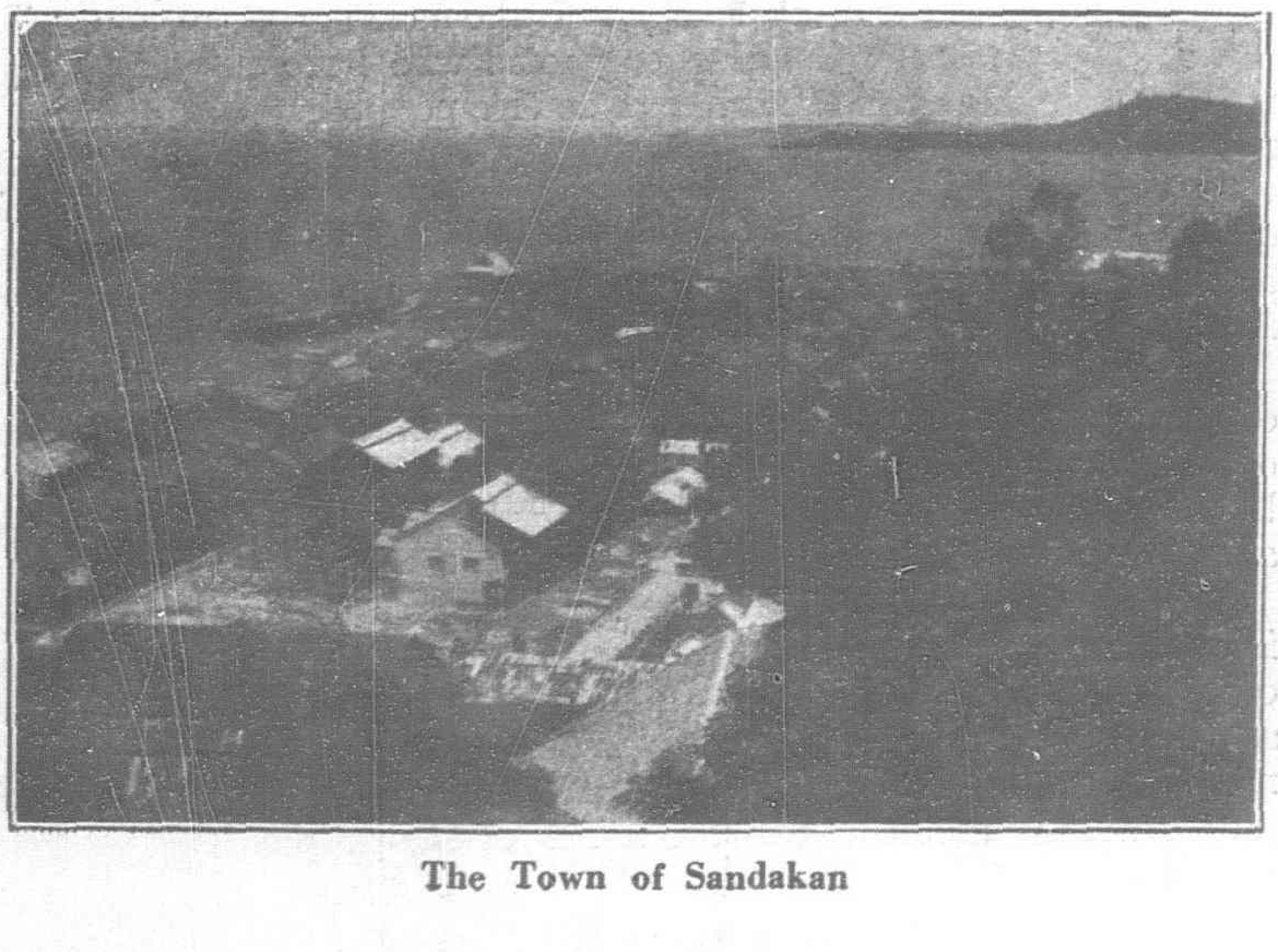
The Secretariat, Sandakan

Sandakan Bay, a magnificent inlet of the sea is situated on the east coast of North Borneo, in latitude .07 and longitude 118. The pioneers of the Chartered Company quickly realized the immense value to them of such a harbor and, in the earliest days of the Company's rule, established a station on the southern side of the bay which they named Elopura. The site was ill-chosen and was subsequently abandoned for the situation on the opposite side of the bay where the town of Sandakan now stands.

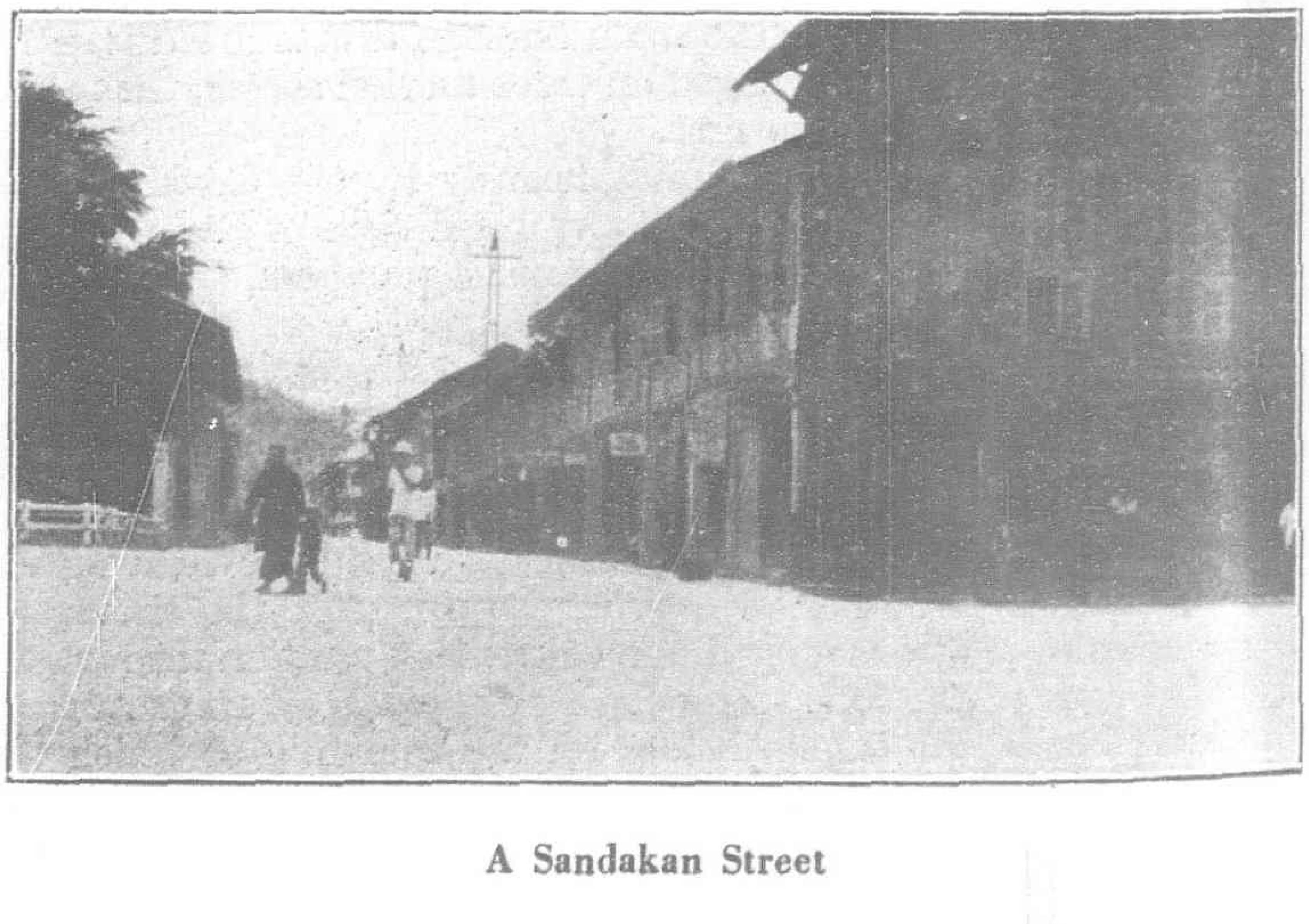
In those days and for many years afterwards Sandakan continued to be little more than a settlement. The protection afforded by the armed forces of the Company gradually attracted Chinese traders who began to push their influence towards the interior from which by means of barter they were able to coax the products of the jungle, rattans, wild rubber, camphor, beeswax, gums, edible birds' nests and the hides of wild animals from the tribes who inhabited the principal rivers, the Kinabatangan, the Labuk and the Sugat. Other settlements gradually came into being on the east coast, the principal being Lahad Dato and Tawao.

It was some years before European capital came in, which it did eventually for planting wrapper-leaf tobacco, and working timber out of the vast forests of the east coast. The influence of capital brought with it European competition in import and export trade, and, particularly during the boom in tobacco planting, there was a great deal of money passing hands in the markets of the newly fledged town. Sandakan has experienced all the vicissitudes of an infant city; born of the energy and enterprise of the old-time pioneer, the temporary home of the creator of wild-cat schemes, the world rover and the beach-comber, she has passed through all the stages and has developed into a flourishing and progressive little city with a population of 11,000 which takes itself and is business with the great world very seriously.

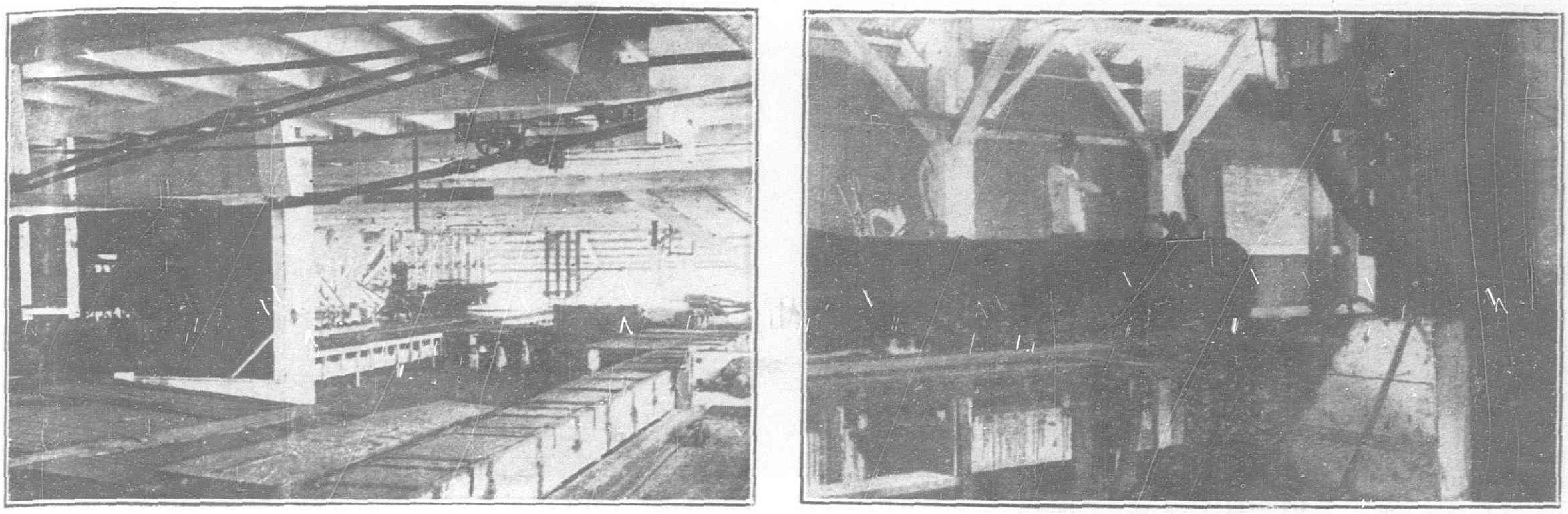
The population in the census of 1921 was returned at 93 Europeans, 34 Eurasians, 9,052 Chinese, 1,153 natives



The Town of Sandakan



A Sandakan Street



SANDAKAN INDUSTRIES—British Borneo Timber Company's Mill

of Borneo, 1,191 natives of the Malay archipelago and 305 of other races.

In 1921 the total volume of the trade of the port was $7,686,305.00 which makes an interesting comparison with the first year of the war. The imports increased from $1,880,663.00 in 1914 to $4,083,627.00 in 1921 and exports from $2,097.57 to $3,602,678.00. As 1921 marked the beginning of the slump and was a bad year in comparison 1920 one may reasonably look for a great improvement as soon as conditions are bettered. Before dealing with Sandakan's trade relations with other countries we will make a similar comparison with the above as regards shipping. The tonnage in and out of Sandakan in 1914 was, inwards 187,059 tons and outwards 186,939 tons of which 75,952 tons were German. The figures for 1921 are inwards 349,290 and out 349,325, of which 219,913 were British, the only competitors to the British flag being the Japanese who entered and cleared 67,000 tons of shipping.

These figures should be a sufficient reply to people who are inclined to regard North Borneo as a disappointment to those who have been interested in her development.

In 1921 Sandakan sold 31,000 tons of coal, mostly for bunker, exported 1,600,000 cubic feet of timber, 19,000 pikuls of copra, 50,000 pikuls of coconuts, 16,000 pikuls of dried fish, 800,000-lbs. of estate rubber, 200,000-lbs. of tobacco and 13,000 pikuls of rattan, to name her leading exports.

Our timber finds its principal market in Hongkong but is also pushing its way into Australia, England and Singapore.

The dried fish trade is principally with Hongkong as is that of rattan. Rubber goes to London and estate tobacco to Amsterdam.

The capital is particularly well situated as regard trade routes as will be seen by a glance at the map. There is direct steamer communication with Singapore, Hongkong, Manila, Zamboanga, Sydney and the Java ports.

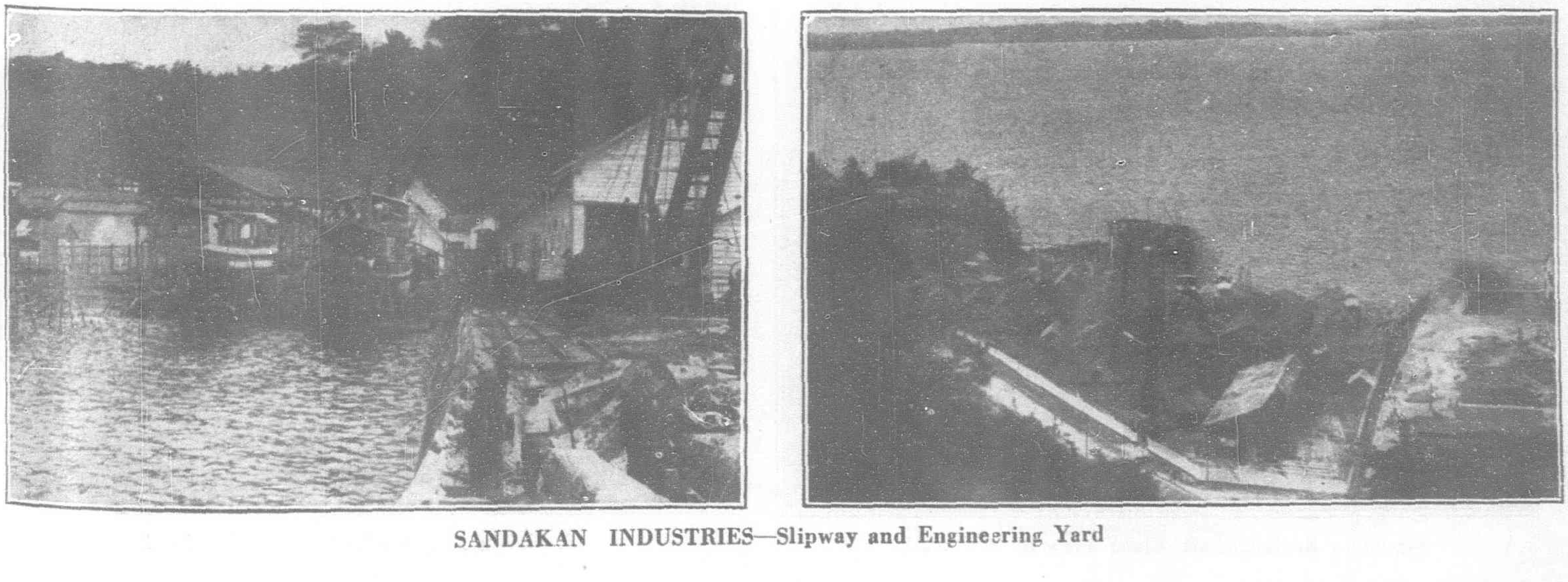
The government maintain two lights on the east coast, one at Tawau and one at Tanjong Unsang which serve for shipping making the Borneo coast from the southern and eastern routes. There is, or shortly will be, erected a third light on the island of Taganac which lies 18 miles of the entrance to Sandakan harbor. This light will assist all steamers approaching the harbor from any direction.

Though there is little at present of a modern nature in the means for docking steamers or handling cargo, the government have schemes for improving the wharfage, increasing the water supply and extending the reclamation of the foreshore to meet the growing demand for space. The latter scheme has actually been put into operation as will be seen by the illustrations to this article.

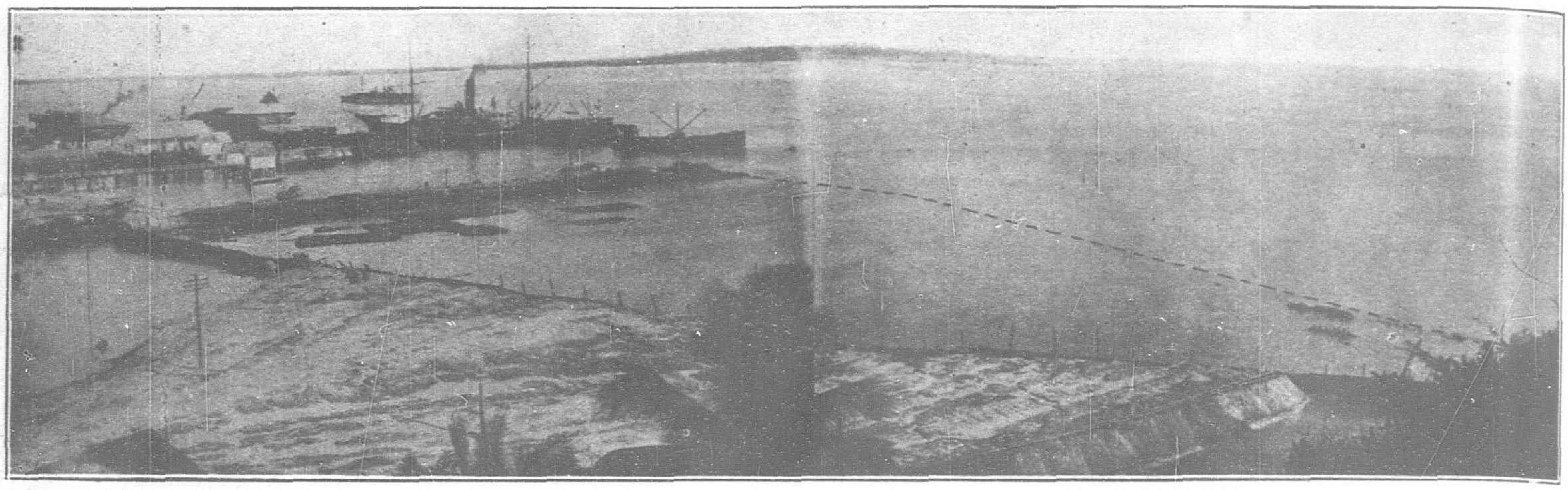
In addition to this they are building a road which will open up agricultural lands and provide settlements for immigrants especially Chinese whom it is hoped to attract.

The present governor of North Borneo, Major General Sir William Rycroft, K.C.B., resides for part of each year at Sandakan where the government has recently built new offices to accommodate the secretariat.

British enterprise is represented in the Capital by Messrs. Harrisons & Crosfield (Borneo) Limited who acquired the flourishing business of Messrs. Darby & Company, the British Borneo Timber Company Limited to whom have been granted a monopoly to export timber, without interferring however with the free rights of former concessionaries in this trade, the principal of whom is the North Borneo Trading Company Limited whose business in timber and engineering is of long standing. The Bakau Company Limited deal exclusively in the preparation of Cutch from the bark of the mangrove tree and there is a well equipped slipway and engineering yard under the management of Messrs. Harrisons & Crosfield.



SANDAKAN INDUSTRIES—Slipway and Engineering Yard



General View of Sandakan Harbor Reclamation. Dotted line shows approximate position of Sea Wall

The capital is well lit and supplied with ample electrical power for its present needs by the Sandakan Light and Power Co. who have recently installed a complete new generating set. This Company was floated in Hongkong by Messrs. Shewan, Tomes & Co. and has been an immense boon to the city.

The Chartered Company opened in 1921, the North Borneo State Bank, and there are agencies of the Hongkong and Shanghai and Chartered Banks.

There is a cinema company which went into the moving picture business some years ago but it does not appear to have aroused much enthusiasm among the people or collected much profit to itself. We seldom if ever see a modern or popular film which the Company cannot afford to lease with their present returns.

The motor car has of course come to stay, though Borneo with her lack of roads logged far behind other countries. The Borneo pony, the Hongkong chair and the lordly victoria owned by a previous governor have disappeared and in their place there is an ever-increasing number of cars, all of an American make. Last but not least Sandakan, which in years gone by was connected with the cable station at Labuan by the tender thread of a single wire stretched across 300 miles of jungle, now forms one of a series of wireless stations the value of which with her growing trade and shipping is of the greatest value.

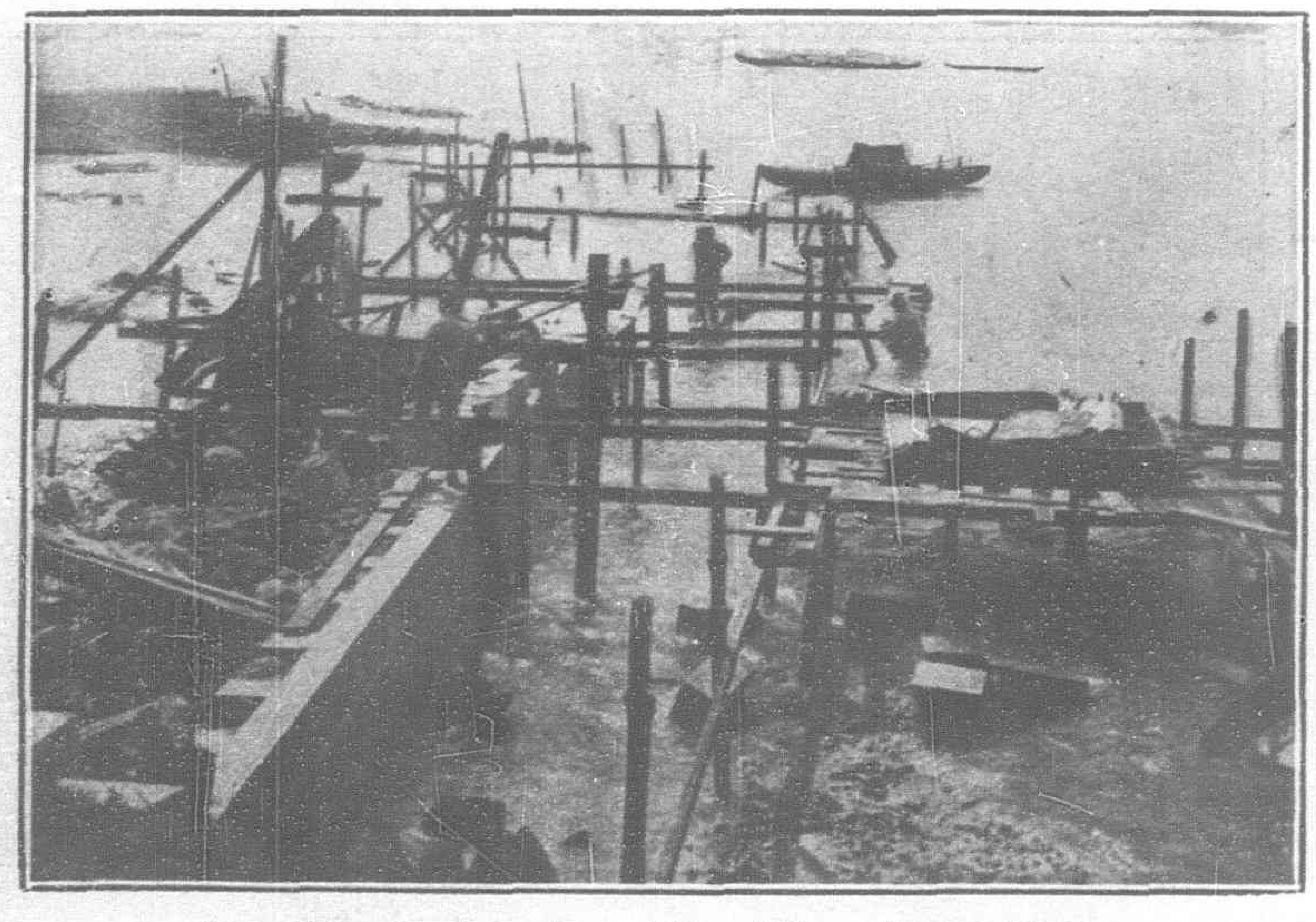
How and to what extent Sandakan is going to expand in the future is a question for which it is not so very difficult to find an answer in the light of what has been done in the last ten years. Though the progress in immigration is likely to be slow it has every chance of being sure and, given the required type of Chinese agriculturist, the lands opened up by the road should quickly be taken up. Sandakan at one time produced considerable quantities of pepper and might again compete in that market through her small holders.

By the terms of the British Borneo Timber Company's agreement their output has to be an annually increasing one until it reaches the region of 4,000,000 cubic feet a year. The timber trade of Borneo has always held its own and our hard woods have for years been firmly established on the Chinese market. They are steadily finding a footing in other markets and it appears to be only a question of time for the country to be able to sell all that her companies can produce.

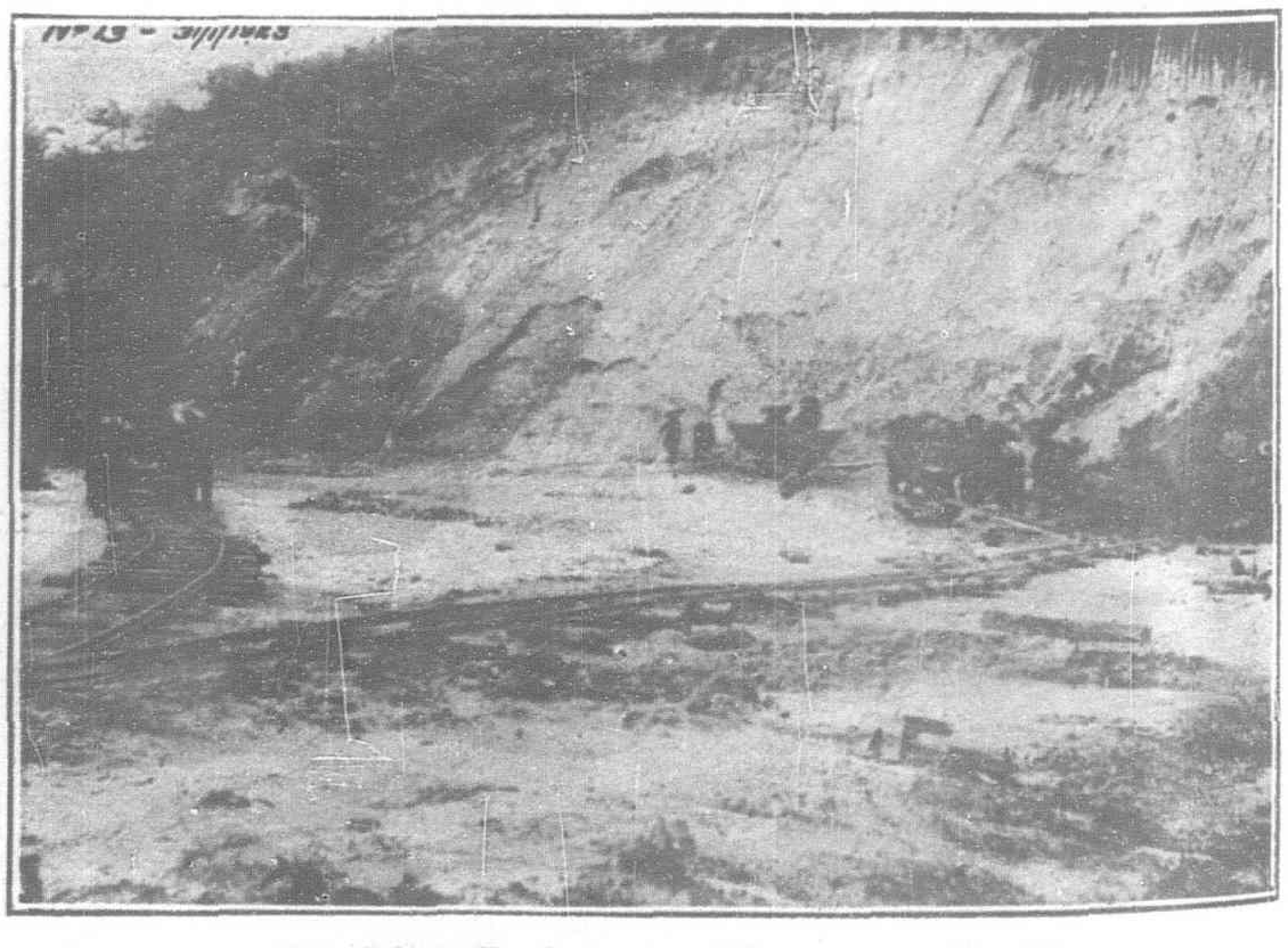
Copra and rubber are both increasing and there is no lack of suitable land for expansion in these respects. The government are making their terms for coconut land more attractive, a policy which is dictated by the slow growth of the palm and the long time between the planting and the productive stage.

An experiment has already been started in the production of alcohol from the stem of the Nipah Palm (nipa fructicans) an industry which is already a flourishing one in the Philippine Islands. This palm grows in profusion on the banks of most of Borneo rivers and the only use to which it is put is the manufacture of thatch from the leaves. The successful development of this industry will mean a great thing for Sandakan where the alcohol will find a sale and means of export.

Though at present of small proportions and comparatively little importance Sandakan is destined sooner or later to take her part in the advancement of trade in the Far East. The pace of development has been slow but it has been exceedingly sure. It is only a matter of forty years since it was little better than an insignificant trading station, laboriously collecting the products of the jungle. To-day it possesses the complete equipment of a modern government and a trade which is making a continual demand for improvements in accommodation and trading facilities.



Sandakan Reclamation: Close View of Sea Wall



Sandakan Reclamation: Excavation for fill

Industrial Survey of Turkestan

ACUTE financial difficulties characterized the operations of all industrial undertakings of the Turkestan republic in 1921 and 1922.

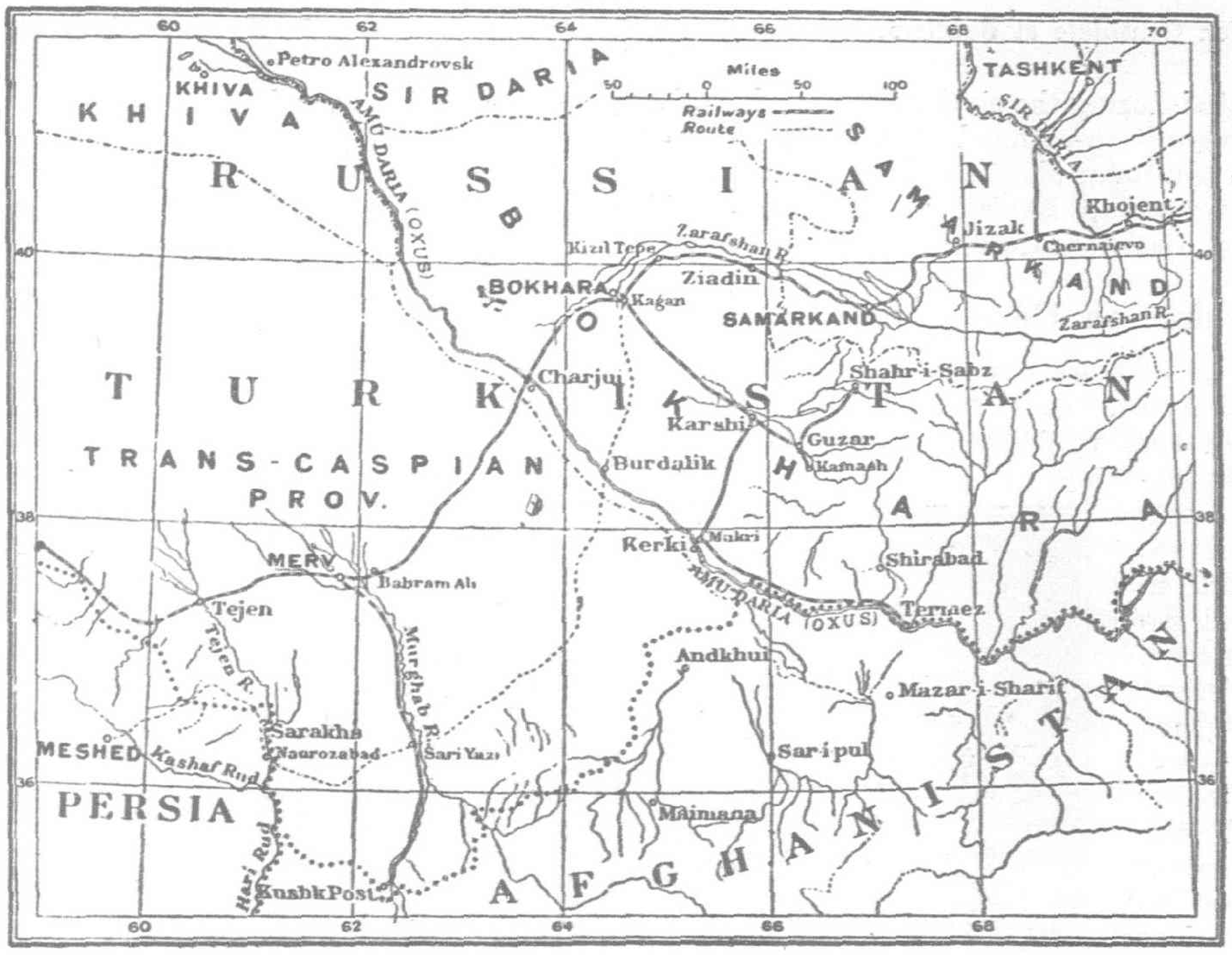
At present the total productivity of all industrial undertakings in Turkestan is estimated at a little over 21,000,000 gold rubles (1 ruble = $0.51), employing a total of 9,000 workmen. A majority of these enterprises are combined into state "trusts."

The central council of national economy of Turkestan is planning to narrow down considerably the basis of nationalized industry, reserving for itself only those branches capable of self-sustenance or essential for the government and turning others over to private management or closing them.

Mineral-Fuel Output —The Wine Trust

The largest trust (known as the "Coal-Naphtha") comprises the four coal mines of Kizil-Keya, Sulucta, Lenger, and Kok-Yanzak and the two oil fields of Santo and Chemion. The output of the coal mines is insignificant. During the first four months of the current year 85 to 90 per cent. of the minimum program was fulfilled, which was set at 2,500,000 poods of coal (1 long ton = 62 poods). Low wages, lack of funds, and civil strife in the region of the coal mines, as well as bad condition of transport, prevent any improvement in the coal-mining industry. The output of the oil fields is somewhat more satisfactory. For the first four months of 1922 about 400,000 poods of oil were produced.

The second important "trust" is that of "Turk-Wine," whose administration is located at Samarkand, the centre of the vineyard region. This "trust" includes 13 alcohol distilleries, 7 wine distilleries, and 9 vineyards. The program for the annual 1921-22 production has been set at 74,100,000 gallons of wine, 7,191,600 gallons of alcohol, 1,300,000 gallons of cognac, and 8,125,000 gallons of vinegar. The season commenced in the fall of 1921 after delivery of the grapes. Up to May 1, 1,716,000 gallons of alcohol and 286,000 gallons of cognac had been distilled. The work of the "trust" was developing normally, with the entire production being consumed locally, until the sudden imposition of an inordinately high excise duty by the central Soviet government curtailed the sales and now threatens to kill production.

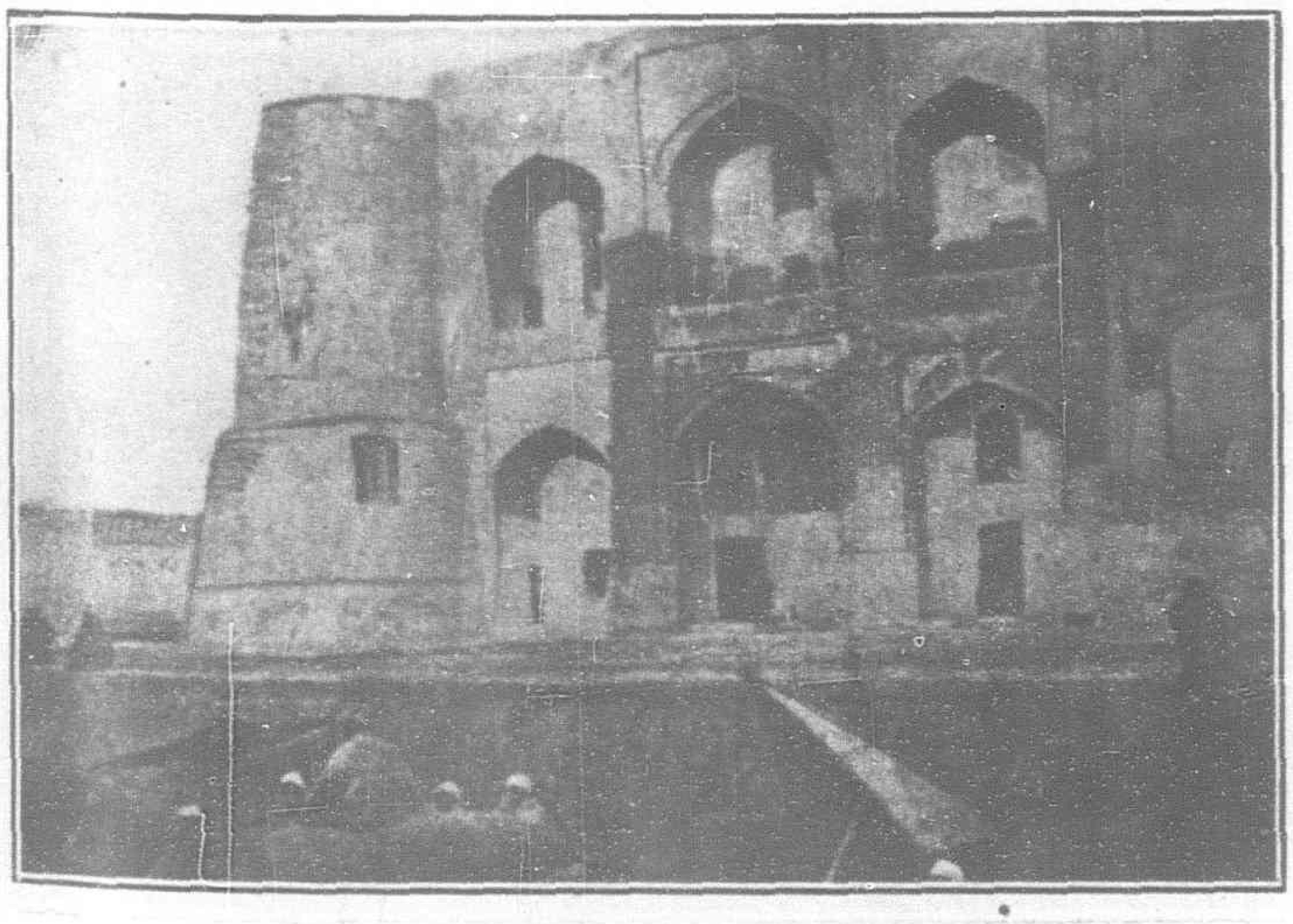


Map of Russian Turkestan.

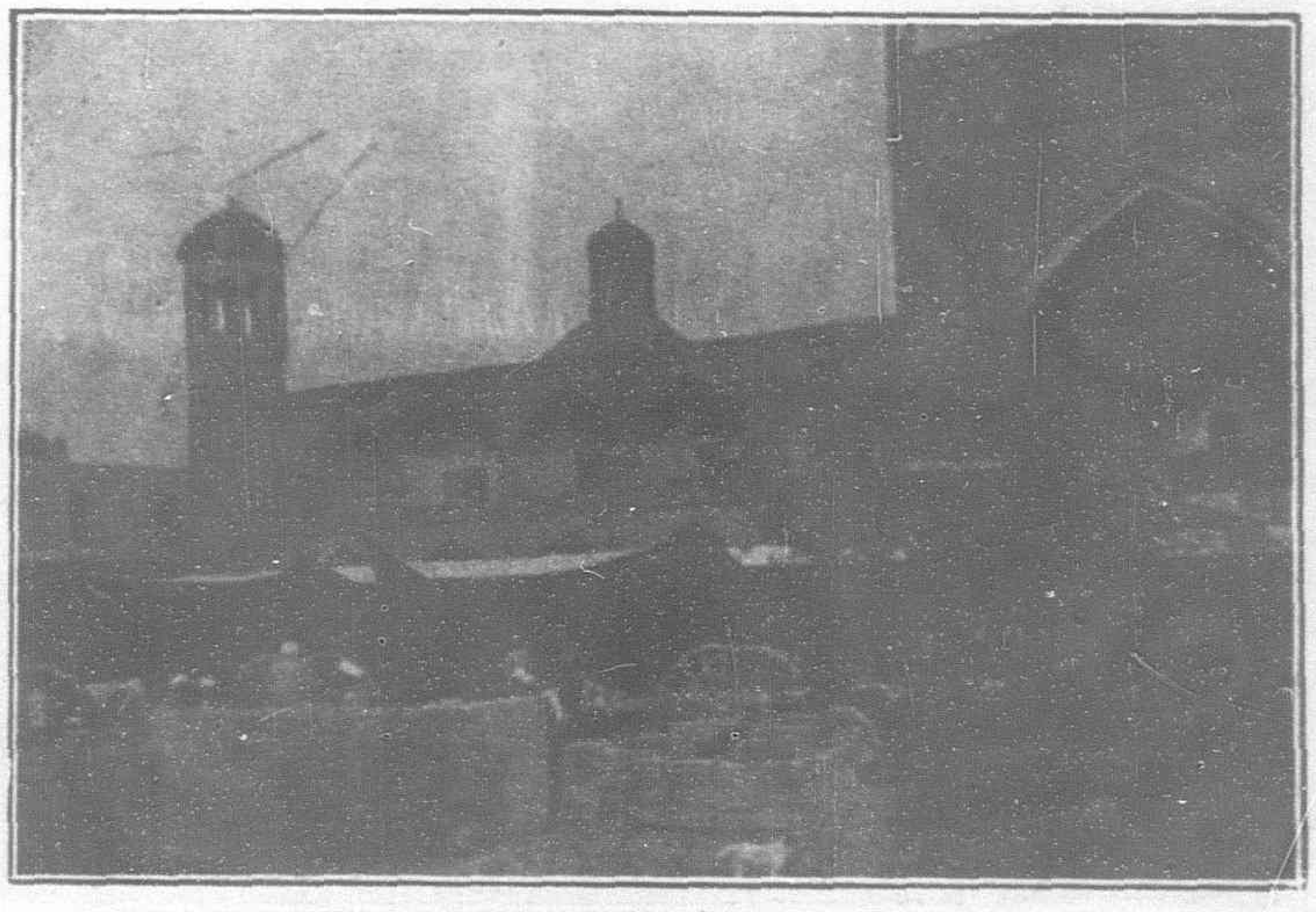
Cultivation of Cotton—Cottonseed Oil

Compared with 1913, the area planted in cotton decreased to one-tenth in 1922, while the collection of cotton fiber, estimated at 1,000,000 poods in 1922, was less than one-twentieth of that in 1915. During the past season only 18 cotton gins, of the 280 prior to the war, were in operation. The cotton-ginning season of 1921-22 gave net results of 290,000 poods of fiber and 666,000 poods of cotton seed. The works were operated at only a fraction of capacity, by reason of slow and irregular deliveries of cotton by the growers, which caused the gins to shut down intermittently. Not more than 100,000 poods of raw cotton are left at the gins throughout Turkestan and not more than 10 gins are scheduled for operation in the coming season.

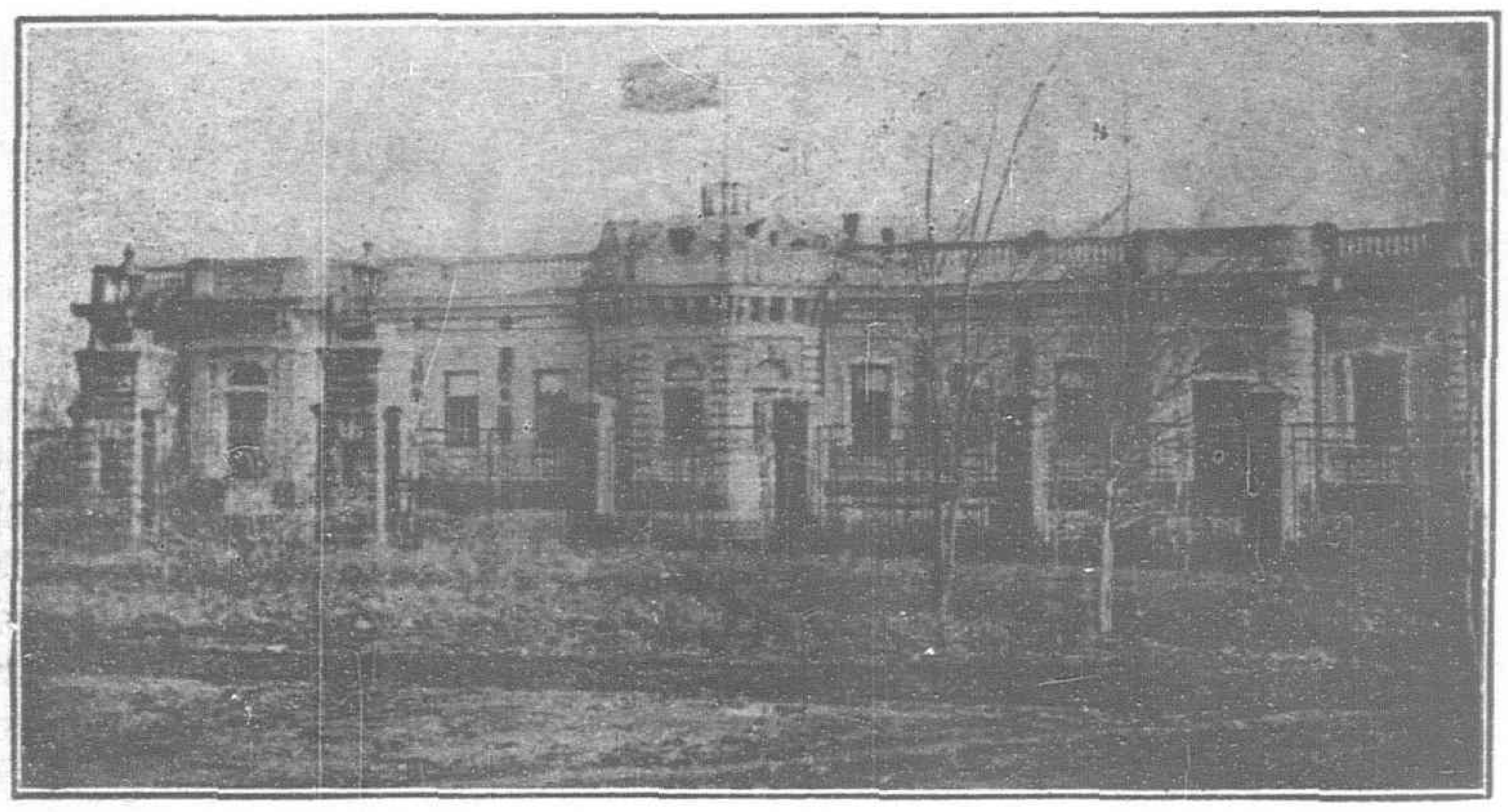
Two oil-crushing plants have been in operation for the past season—one at Khokan and one at Bairam-ali. At the first-mentioned plant 242,000 poods of cotton seed were crushed, while the second plant worked up 258,000 poods. In view of the fact that the best oil-crushing plants were situated in the Ferghana



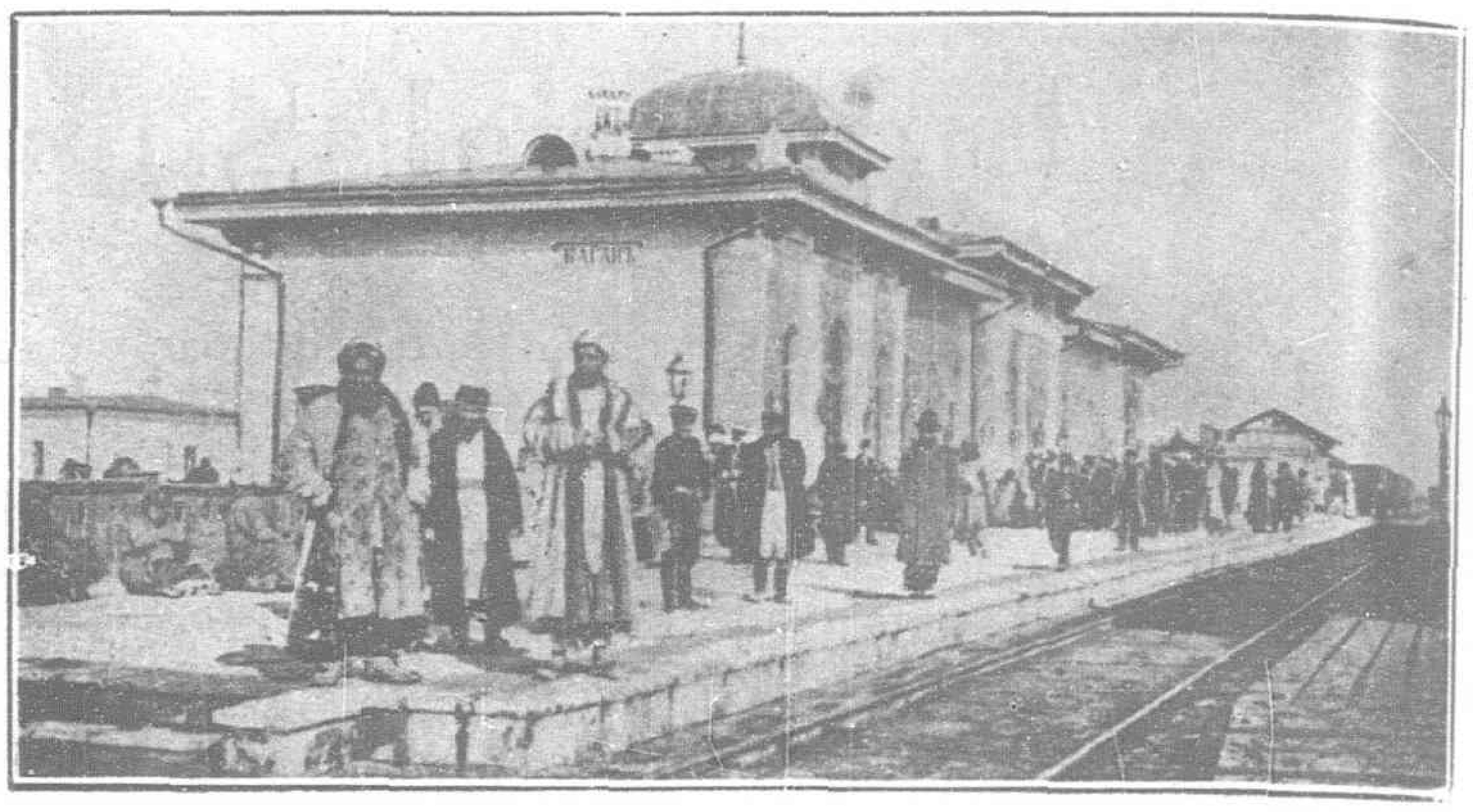
Cotton Yarn Depot at Bokhara.



The Mosque and Market at Kokand.



The Russian Consulate at Bokhara.

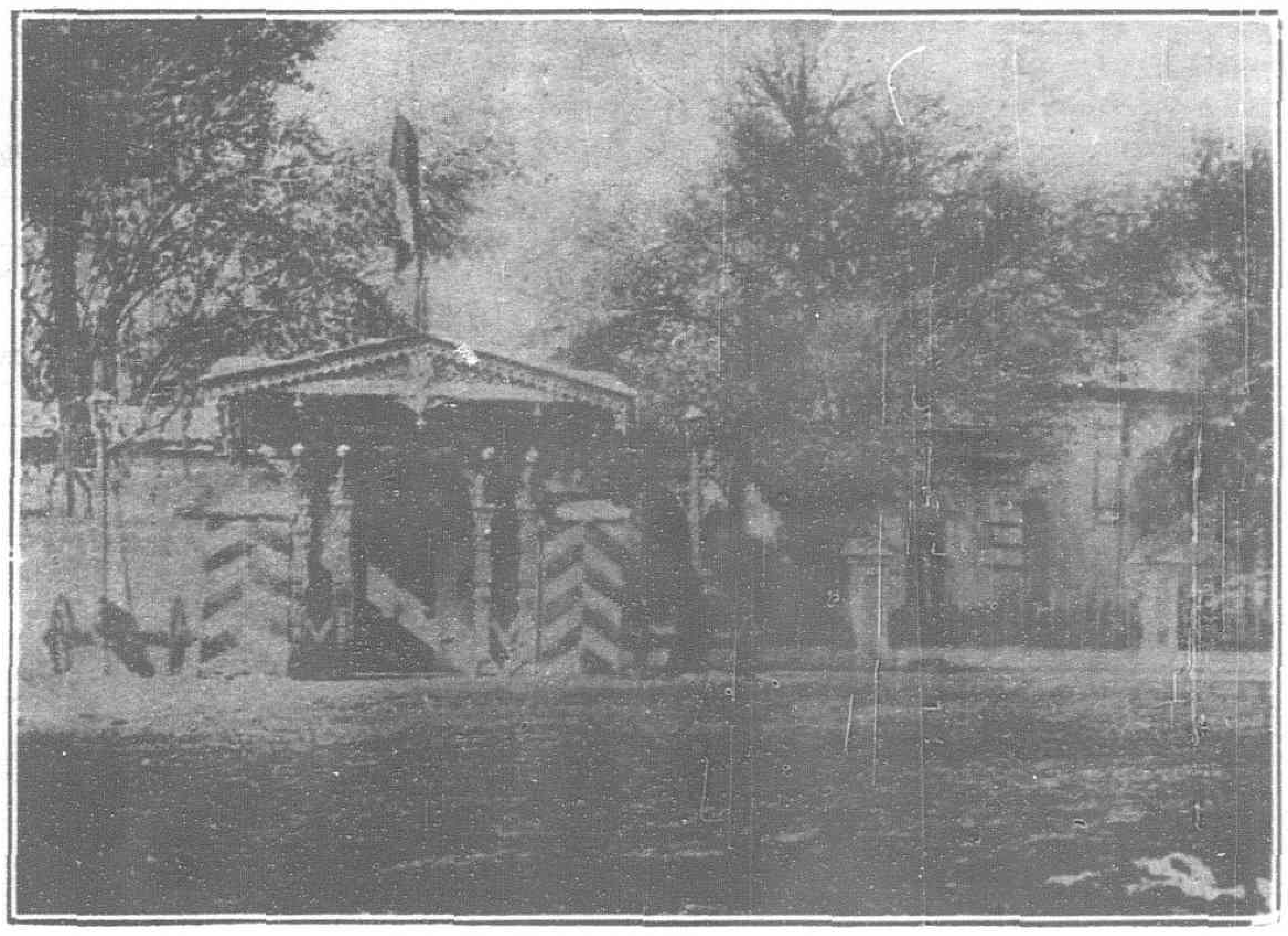


St. Kagan Railway Station, Bokhara.

province, which was desolated during the civil war, new oil-crushing plants are necessary, and have been planned in more advantageous points of Turkestan. The Kaufman plant has been completed and is in operation, having worked up 100,000 poods of seed. The Khokan plant will not be in operation during the coming season.

Silk Production Developing

In 1914 the breeders of silkworms received 190,000 boxes of eggs; in 1919, only 11,163 boxes. In 1920 the number of boxes increased to 30,612, and in 1921 to 34,000. In 1922 there were 52,500 boxes distributed by government nurseries and trading institutions and 5,000 by private growers. Of the 1922 total, 40 per cent. was received from the home production and 60 per cent. was imported from the adjacent countries of Persia and Afghanistan. The abolition of state monopoly on silkworm breeding and trading stimulated the industry. This year's harvest amounts to from 120,000 to 150,000 raw cocoons, valued at between 2,000,000 and 2,500,000 gold rubles.



Russian Government House at Tashkent.

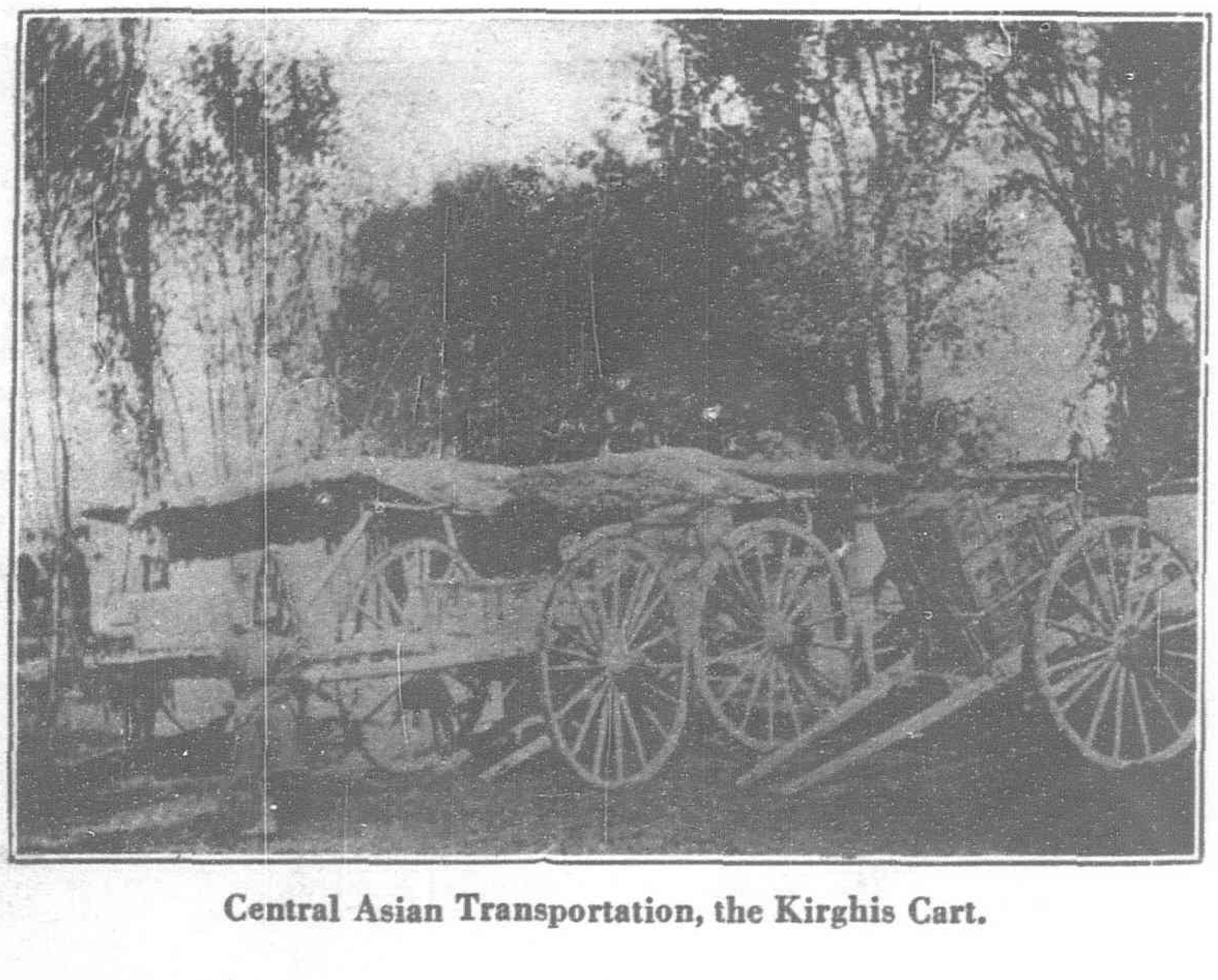
The yearly requirements of the Russian silk mills before the war amounted to 110,000 poods of raw silk, while Turkestan was able to produce 15,000 poods at the most, with the aid of mechanical contrivances for unwinding of cocoons. The maximum production of Turkestan, with mechanical unwinding, could amount at present to only 7,000 poods of raw silk; but as most of this operation is being done by hand, the actual amount obtained will be much smaller.

Tashkend Wood-Pulp Plant—Sugar Industry

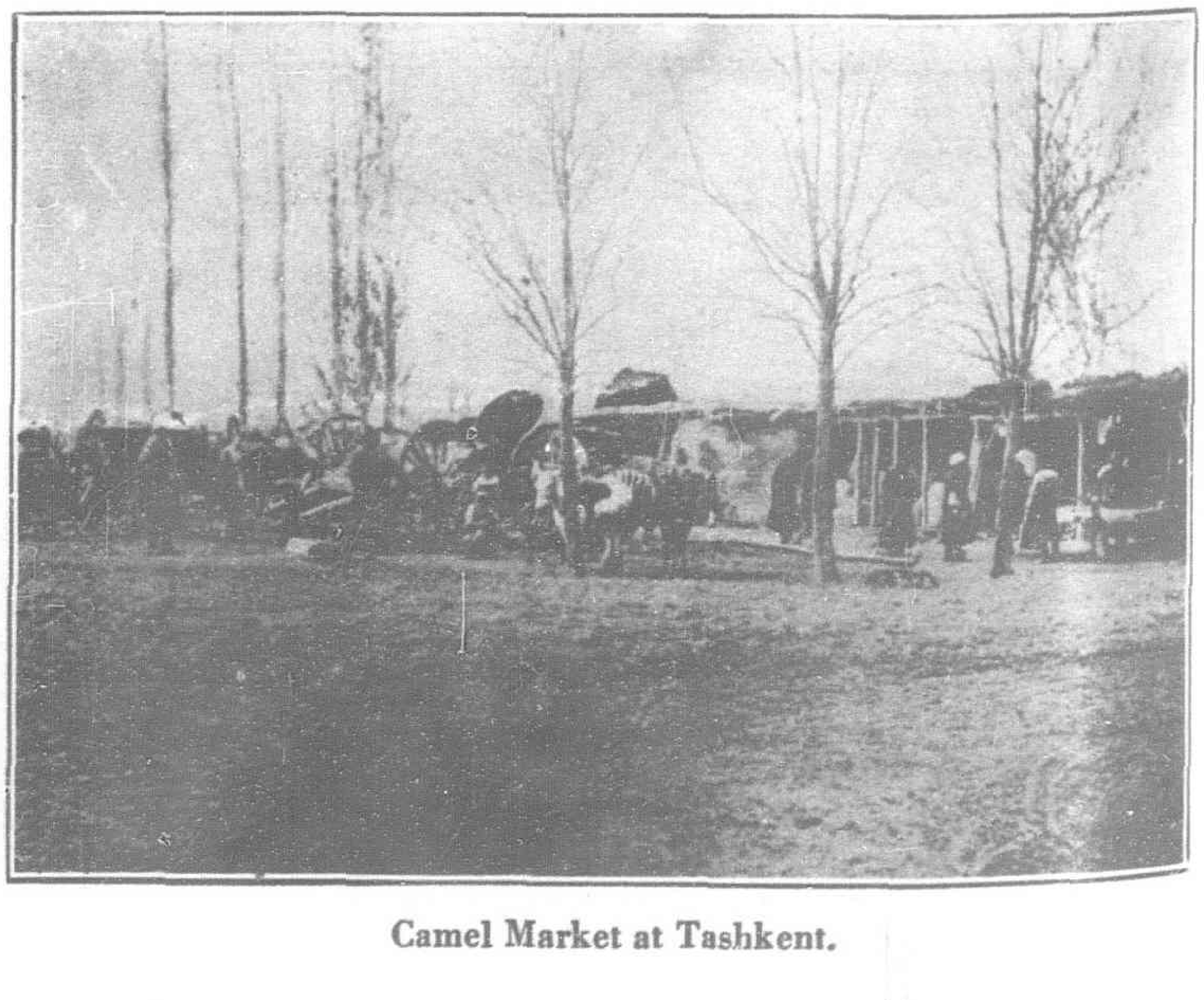
During the war construction of a huge wood-pulp plant along the most up-to-date lines was commenced at Tashkend. After the revolution difficulties arose in connection with the deliveries of machinery and other technical equipment, which has been proceeding very slowly. The same situation exists in regard to the paper factory, which forms a part of the complete plant. All building construction is complete.

Completion of Semiretchensk Railroad

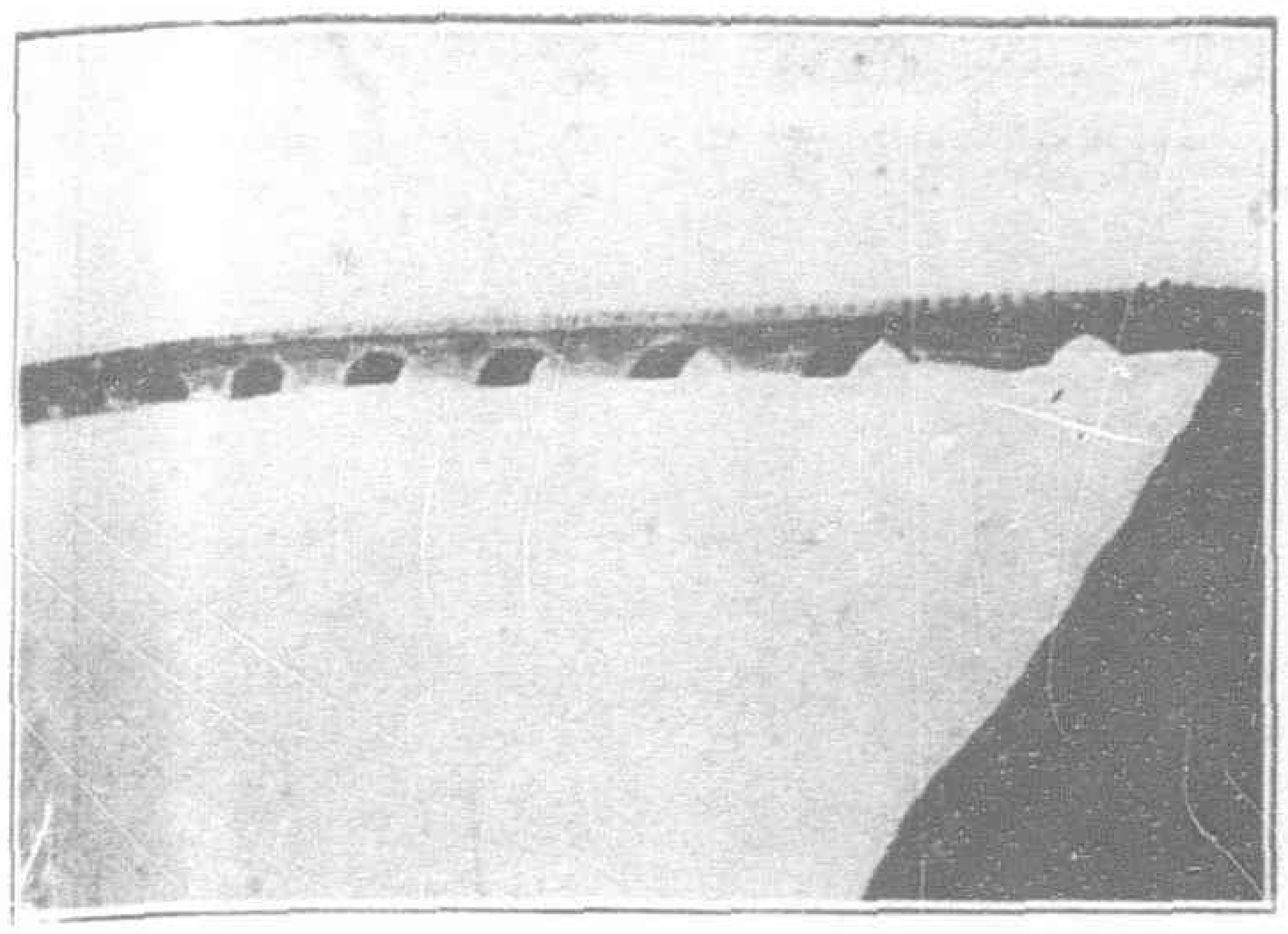
The most vital problem affecting the economic life of the Turkestan republic and, indirectly, that of Soviet Russia, is the completion of the Semiretchensk Railroad. Construction on this line was commenced toward the end of 1913, and in November, 1920, service was opened on the section from Arys (terminal) to Owliay-Ata (Aulie-Ata)—a distance of 155 miles. At the present time construction of the roadbed has been completed from Owliay-Ata to Pishnek, but further work is suspended for lack of rails, ties, and part of the bridge work. This last section will serve three of the most fertile districts of Turkestan—Pishnek, Vernen, and Przevalsk (Karakol).



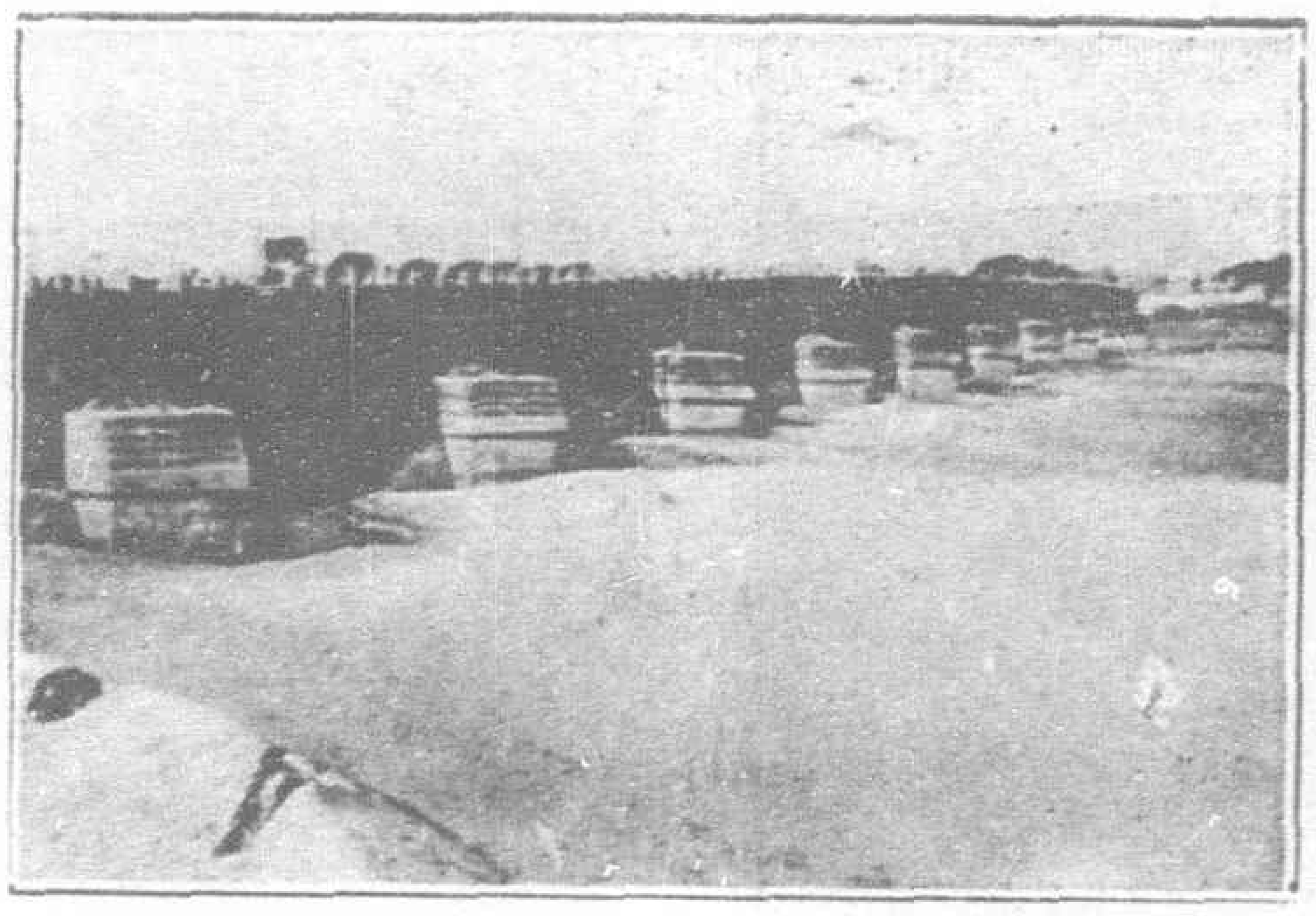
Central Asian Transportation, the Kirghis Cart.



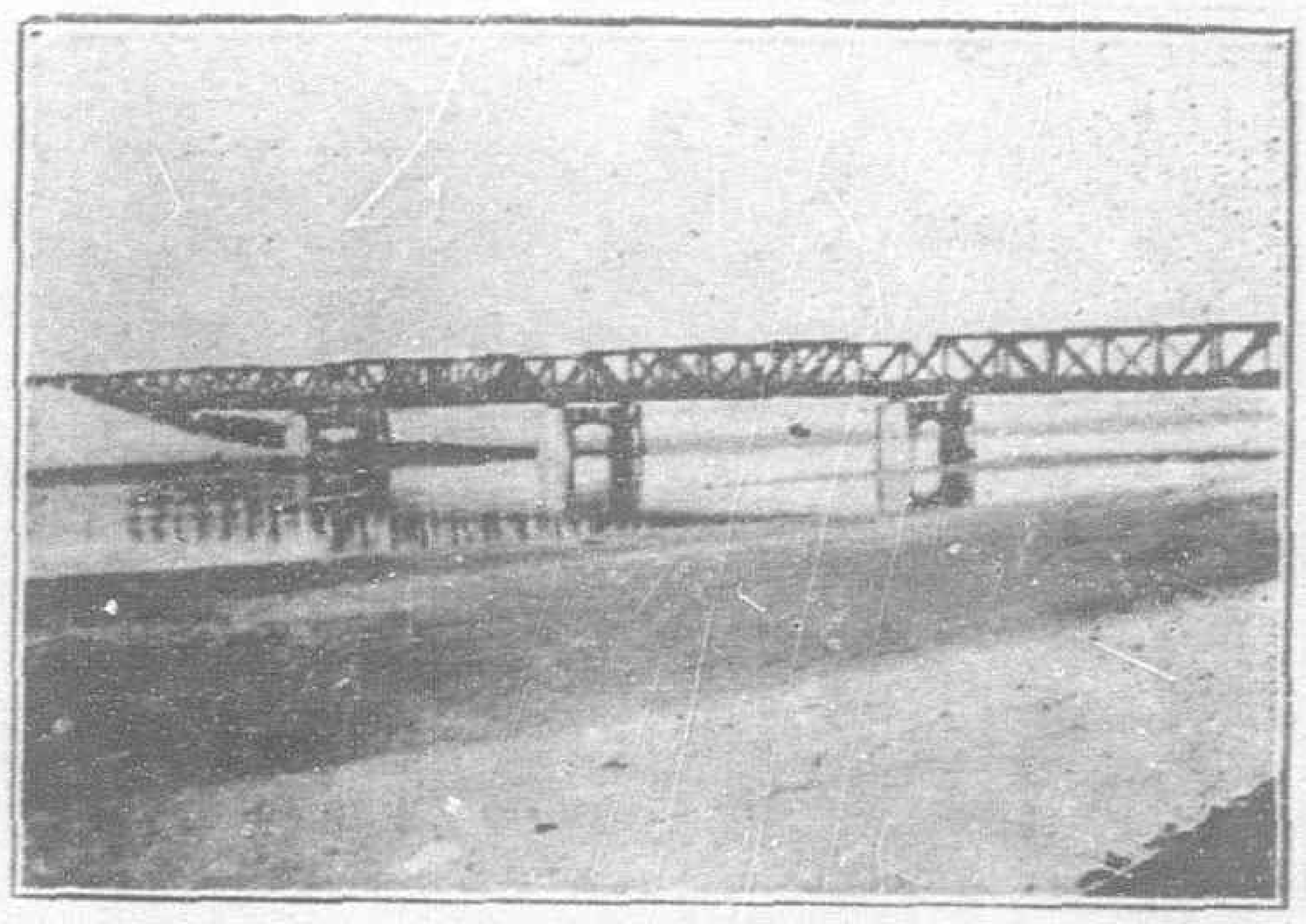
Camel Market at Tashkent.



The lower side of the Marco Polo Bridge on the Hun Ho, showing the silting of the channel



The upper side of the Marco Polo Bridge, showing the confined space for the passage of flood water



The railway bridge at Lukouchiao, showing the wide spans, a contrast to the usual Chinese practice in bridge construction

Conservancy Work in North China

By Laurence Impey, A.M.I.M. and C.E.

It is probable that there is no country in the world that has suffered more greatly in the past from the misdirected energies of her rivers than has the so-called "Celestial Kingdom" of China; and it is therefore with the greater interest that one studies the conservancy work carried out there in bygone days and compares it with that executed abroad at the present time under the guidance of modern engineering science.

It would appear to the writer as a result of this comparative study that either the Chinese as a nation have lost the engineering skill which is exemplified in the construction of such works as the Grand Canal, the Marco Polo Bridge, the old drainage and canal system of Peking, and the dikes which used to guide most of the important rivers of China; or that they are become a people which is no longer interested in the public welfare and whose executives are incapable, venial, or both.

Hardly a year passes without reports of disastrous floods in several provinces being forwarded to the central government, floods which could easily have been prevented by engineering investigation and constructive action on the part of the provincial authorities, if these gentry had been willing to exert themselves sufficiently, but which as a result of their criminal negligence inundate large stretches of farming land and destroy crops, live stock, houses, and even entire villages.

As an example of conservancy work of the old and the modern school one cannot choose a better study than that afforded by the river and canal system of Chihli province, for the network of waterways draining that area cover a very large portion of North China itself.

This river system is the more important in that it affects the area between and around the important cities of Peking and Tientsin, both draining the surrounding country and serving as water communication between the last named treaty port and the sea.

In bygone days this water transportation was of such an order that the tribute barges and ships used to proceed as far as Tungchow to discharge their merchandise intended for the imperial capital, whither it was then conveyed either by canal or by road.

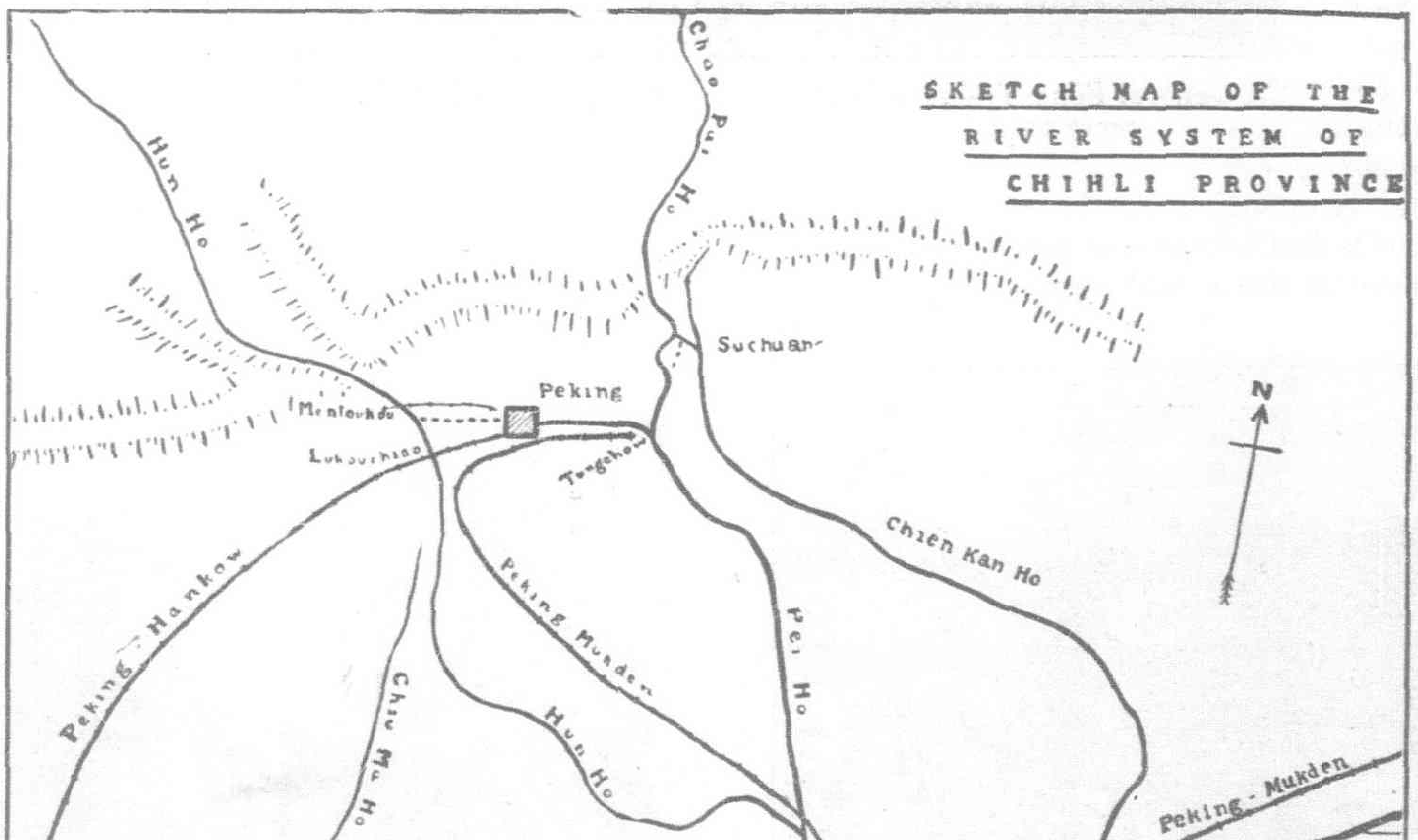
Now, however, all this is changed, the vast stone wharves are sliding into ruin, and the very bed of the river itself is almost dry, largely as a result of lack of maintenance and in attention to regulating works on the waterways concerned.

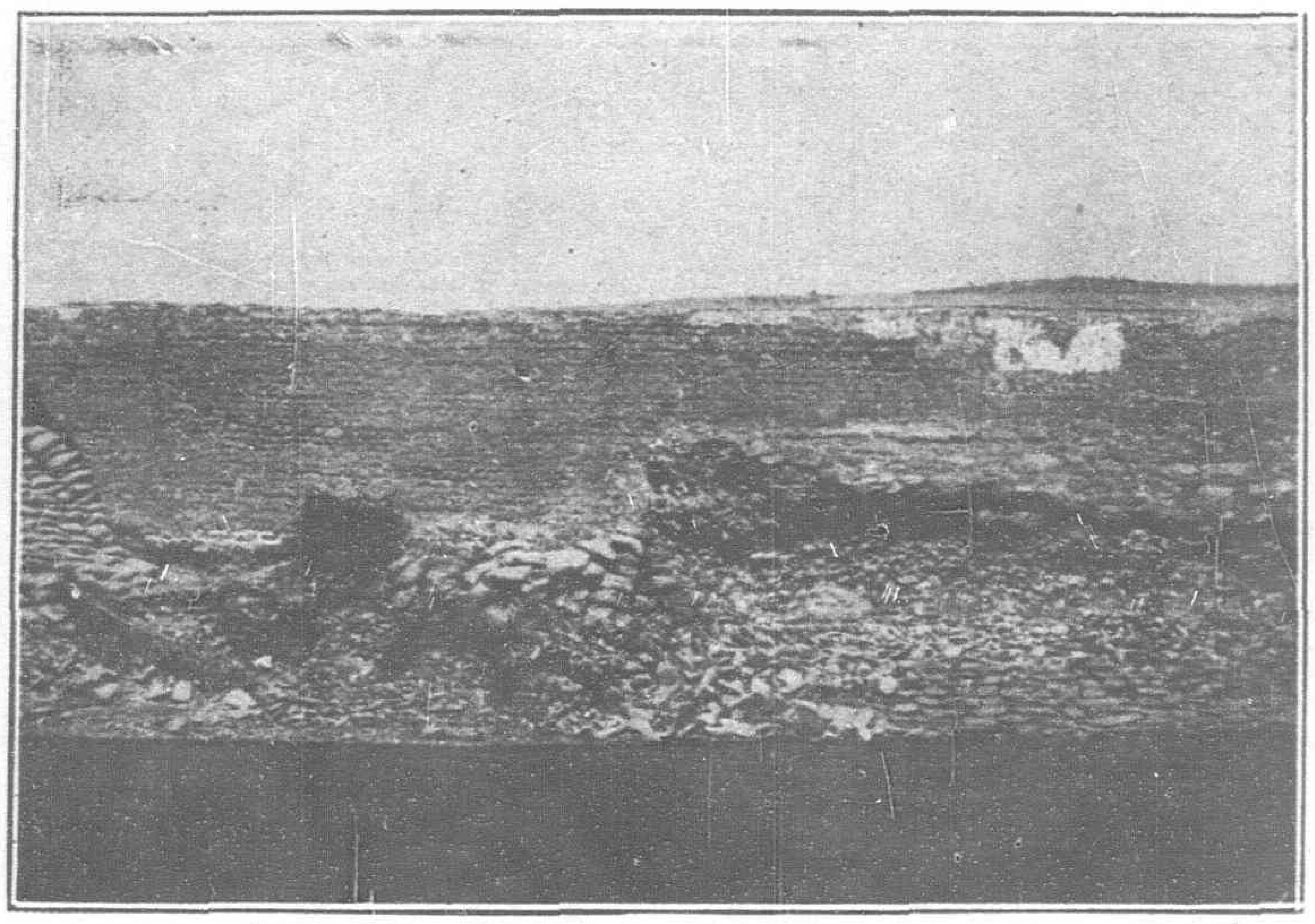
Not only this, but every ten years or so there is a disastrous flood somewhere in the area between Peking and Tientsin, seriously threatening the latter city, usually caused by the breaking of the dikes of the Hun Ho (sometimes known as the Yung Ting Ho) as a result of inattention to maintenance work.

The Hun Ho (Yung Ting Ho) has a drainage area of some twenty-two thousand square miles in all, from its source in the mountains of Shansi to its junction with the Pei Ho above Tientsin, but, as is common with Chinese rivers it is practically dry during six months of the year, having a depth of only two or three feet previous to the coming of the rainy season.

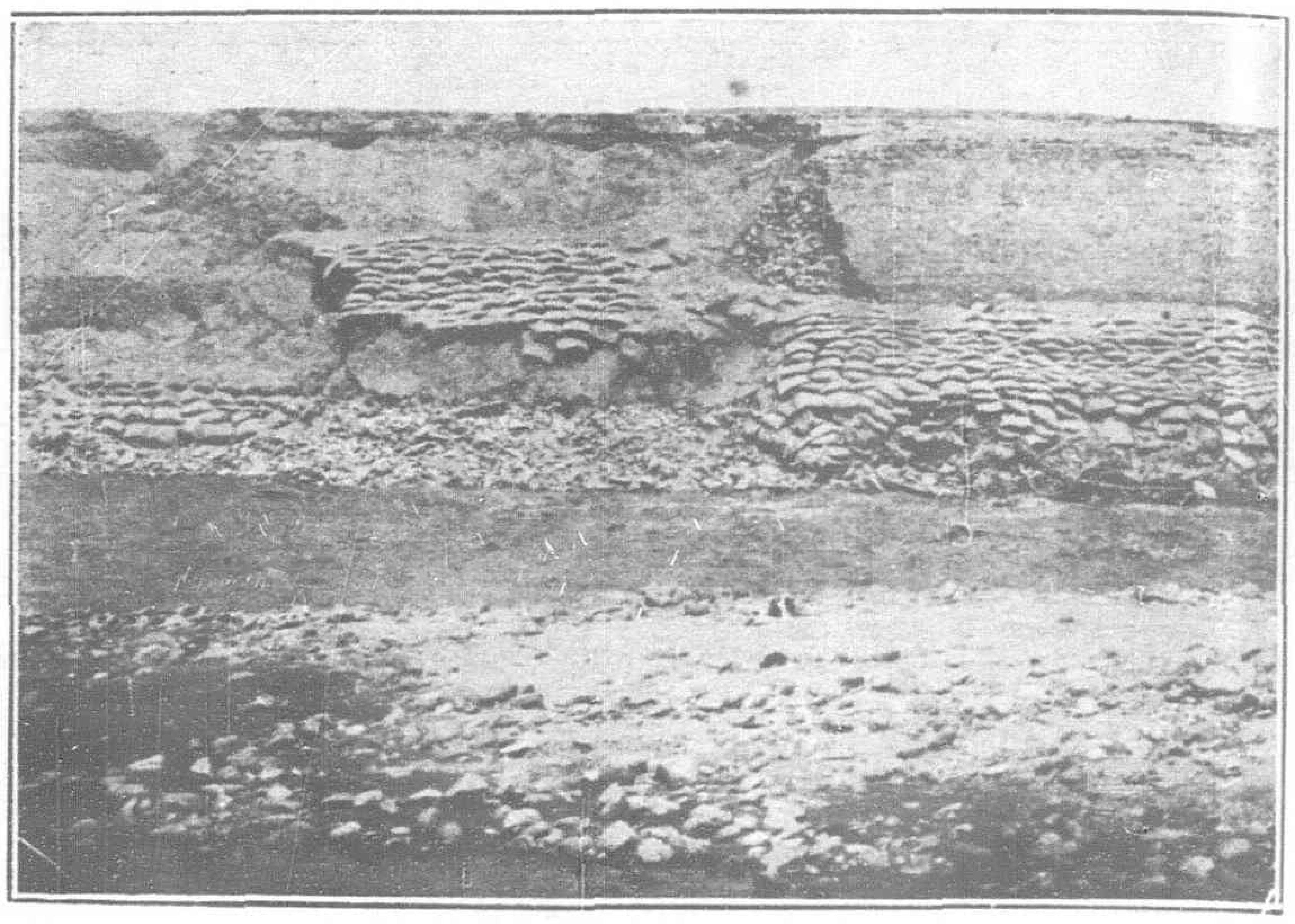
Owing partly to the precipitous nature of its catchment area in the hills and partly to the lack of trees or other vegetation in that area, the scour is considerable and it has been estimated that during the flood season the Hun Ho carries down some twenty-five per cent. of solids in its course.

This accumulation has a natural tendency to settle as soon as the current becomes less swift, and as a result the bed of the river has actually risen over six feet above the level of the surrounding country in its lower reaches, and is therefore only controlled by its system of dikes.





The rock facing higher up, showing sandbag and wattle reinforcement, both equally inefficient.



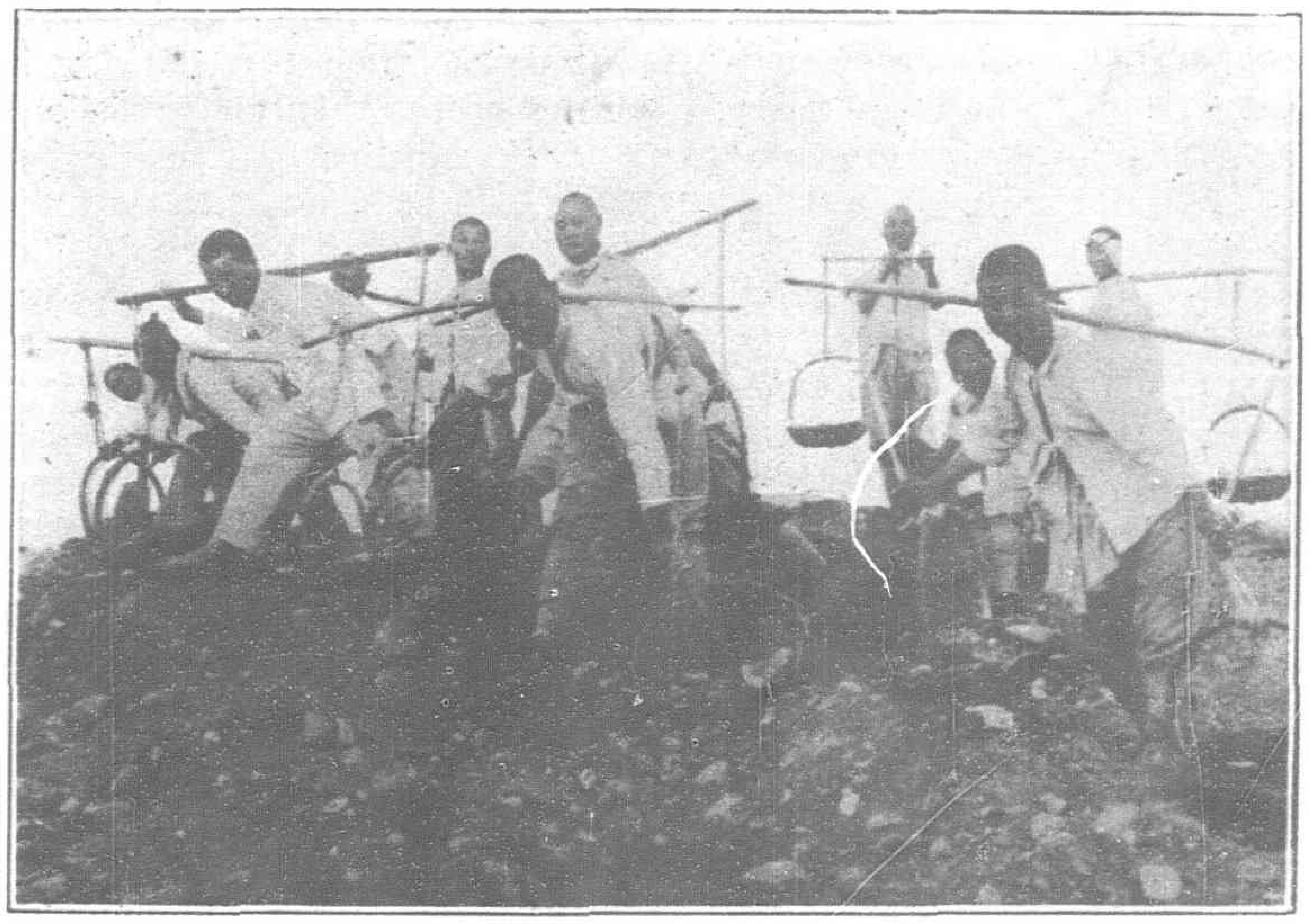
The ruined rock facing at the lower end of the work, showing the shallow nature of the river in the dry season

These dikes were solidly constructed in the first place, the stretch from the hills in the neighborhood of Mentoukou down to the Marco Polo Bridge or Lukouchiao being defended by masonry of great strength, which only time and neglect have combined to undermine in certain places.

The engineers appointed under the old imperial regimé placed their retaining dikes some six hundred yards apart in most places, so that the channel is of such a capacity as to be almost dry as a rule, and it was only at the entrance of the Hun Ho into the Pei Ho that they adopted another formation.

Here the river was allowed to expand into a delta, covering some four hundred square miles in all, upon which the silt brought down in the flood season could be deposited in some measure, instead of forming an obstruction in the channel of the Pei Ho.

This proved effective to a certain extent, though the construction of the bridge at Lukouchiao, famous through its mention in the annals of Marco Polo, proved an obstruction sufficient to serve as a cause of considerable silting, as may be observed in the accompanying photographs.



General Feng Yu-hsiang's soldiers as transporters of earth. They were paid merely their subsistence rates on the work

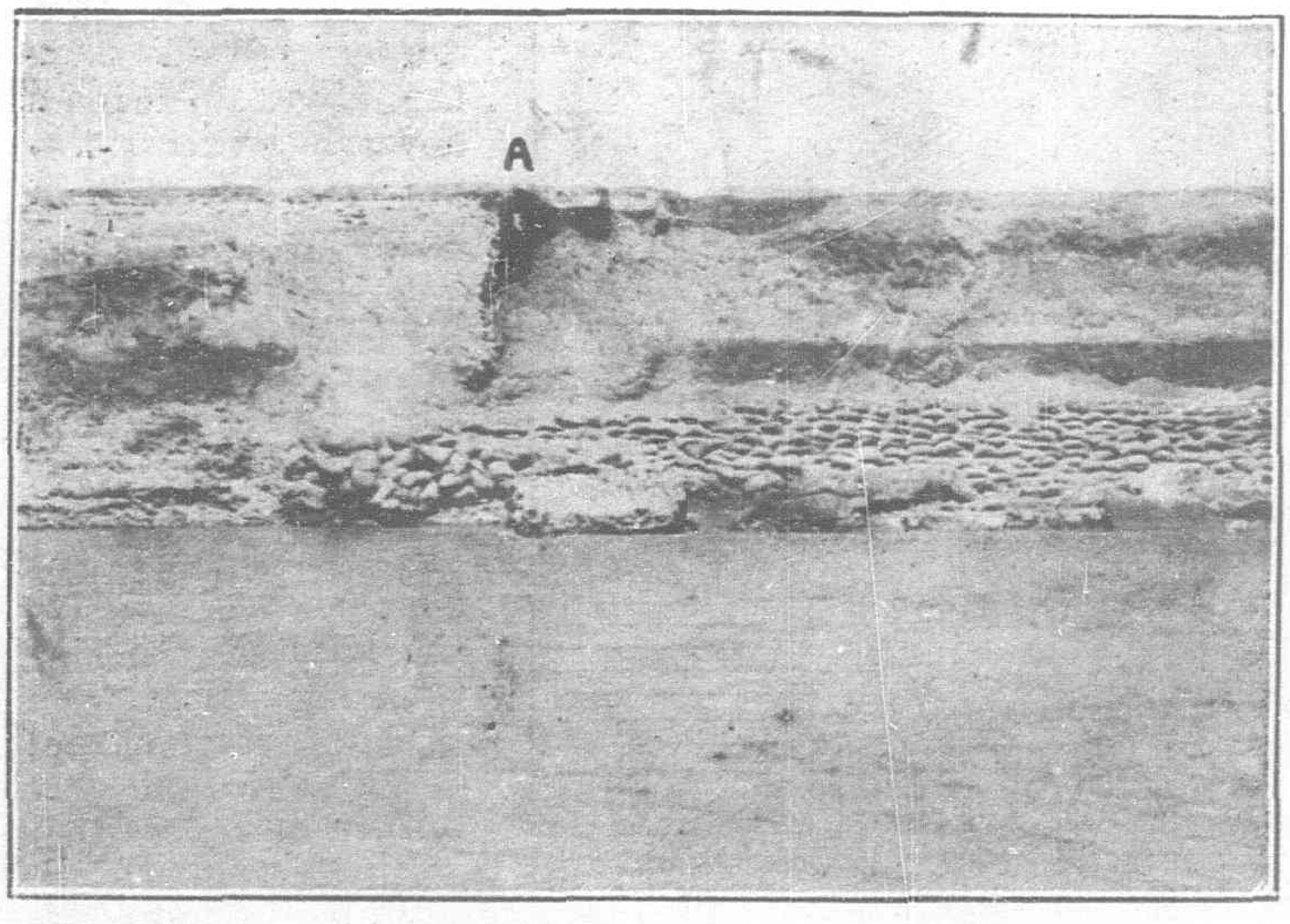
The sand deposit has gradually risen above and below the bridge, until the arches can only accommodate the flood flow with the greatest difficulty, as can be realized when it is noted that it is registered at 105,000 cubic feet per second as in the flood season of 1922.

The railway bridge immediately above this point has a wide span, and it seems unlikely that it will ever be either seriously threatened or prove an obstacle to the flood current, sufficient to cause any large deposit of sediment.

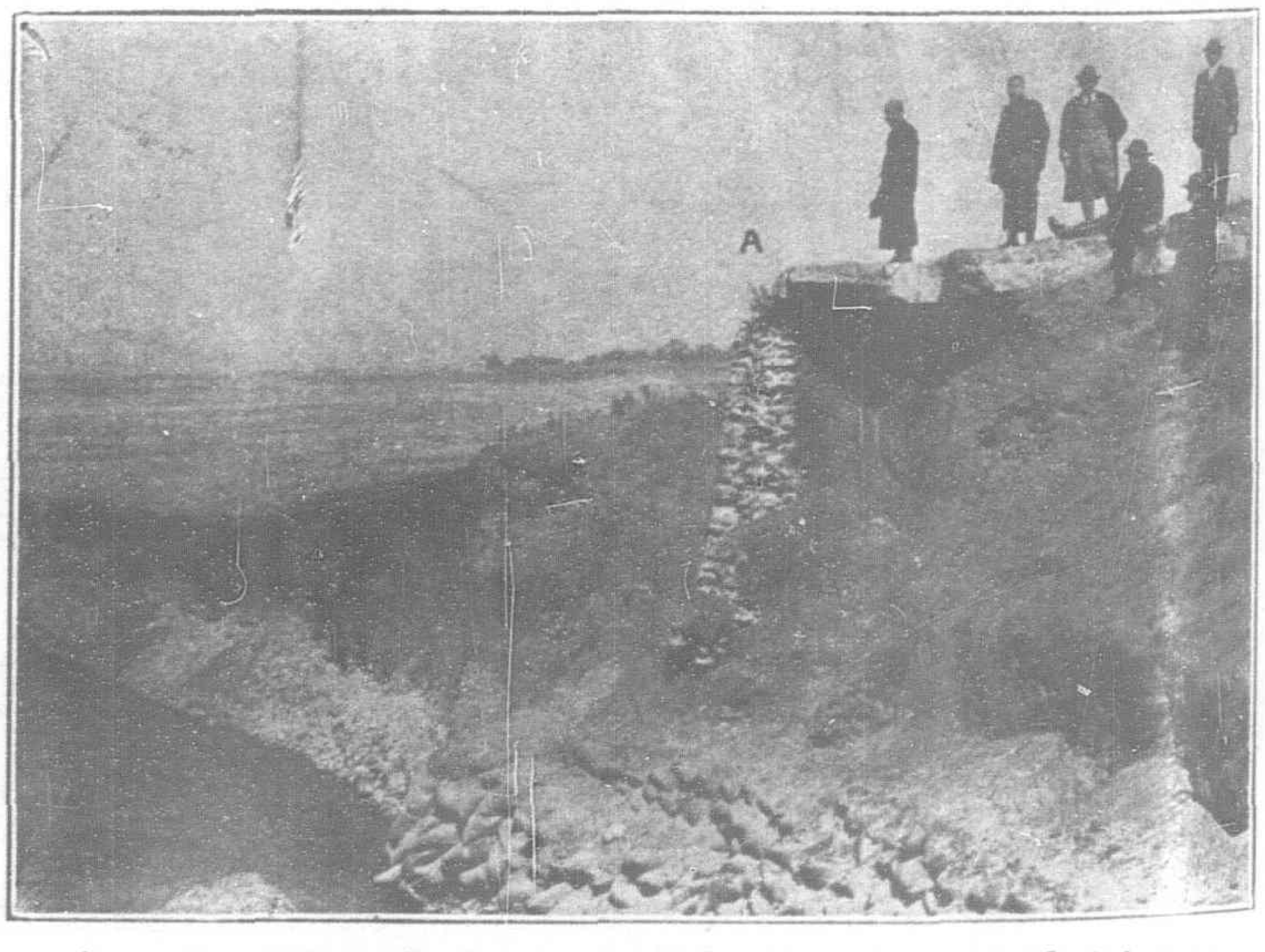
In 1922 the river rose to such an extent as to threaten a disaster, and it was with the utmost difficulty that the dikes were maintained during the short rainy season of July-August, very considerable damage being caused to the rock facing of the levee in various places.

So threatening was the situation that the ministry of the interior alloted $110,000 to the conservancy board responsible for the maintenance work, though reports state that this payment has never been made owing to the financial difficulties of the government.

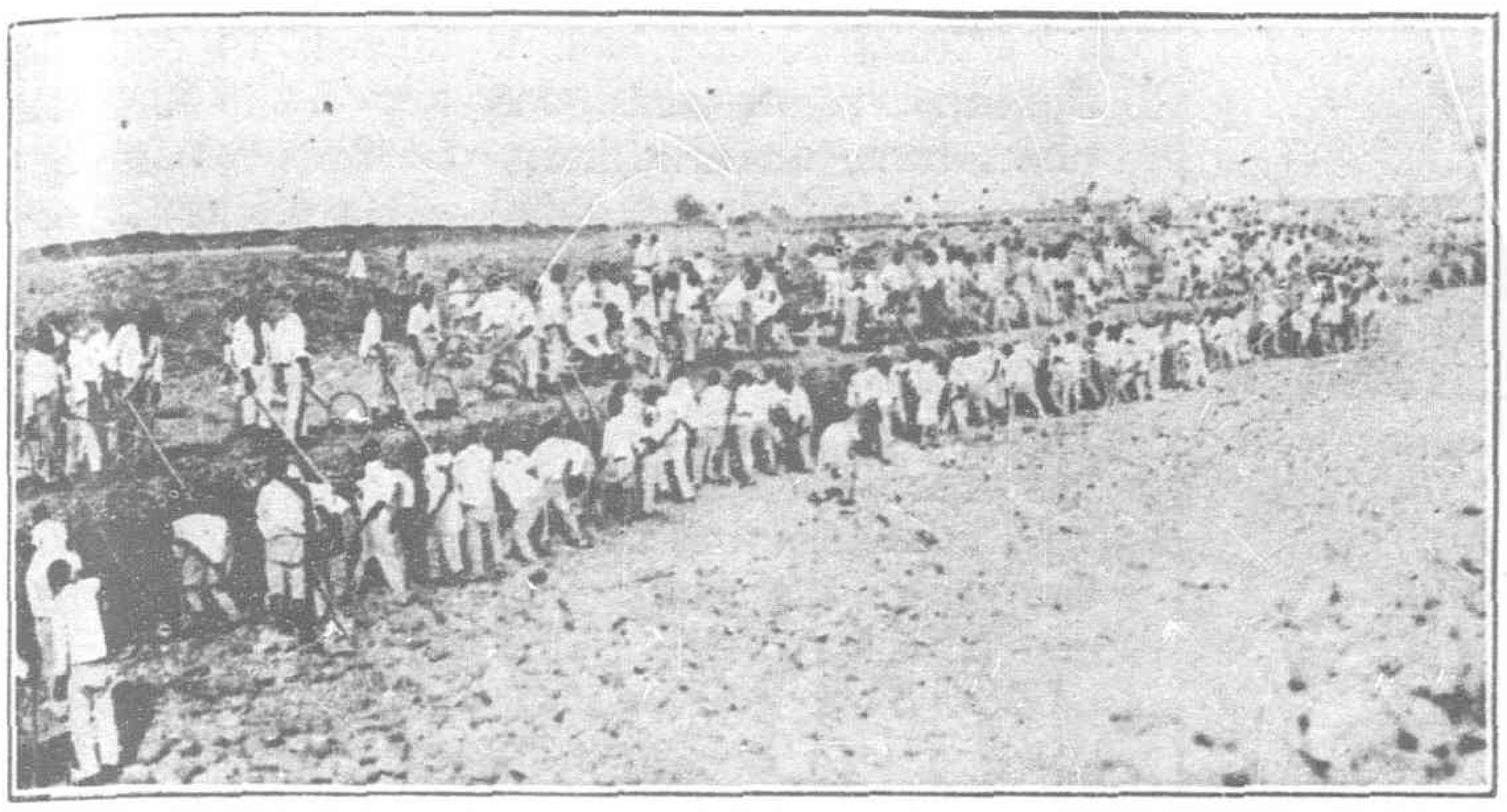
The conservancy board borrowed $60,000 at 8 per cent. repayable in eight months from the Peking committee of the China



The levee at the point indicated in the other sectional photo, where the wall has entirely collapsed



A section of the wall, showing its lack of foundation, and giving an idea of the flat country surrounding the river until it reaches the hill



View of the diversion channel, note the military discipline

The construction of the dam prior to the diversion of the river

international famine relief commission, guaranteeing to maintain the Hun Ho dikes during the 1923 floods with this sum.

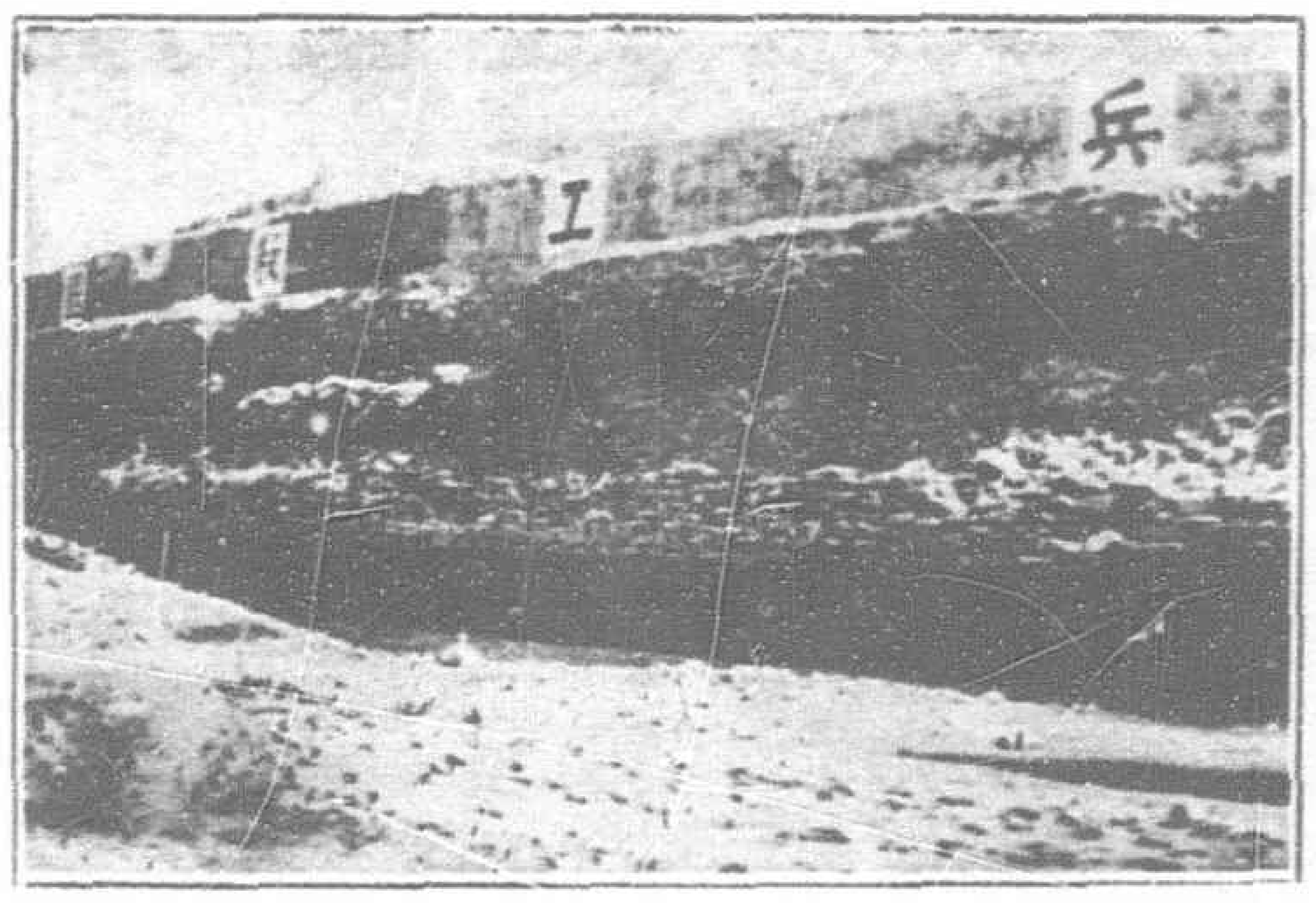
The most dangerous point on the river was decided to be one on the north bank between Mentoukou and Lukouchiao, where the flood current last year had attacked a spot at the junction of some new and old masonry facing and undermined the rock protection of the dike over a distance of some twelve hundred yards.

Estimates for the repairs vary considerably, one engineer suggesting that $10,000 would be sufficient, while another stated that it would require the full $60,000, the writer's opinion is that a satisfactory job can be done for $40,000 approximately.

In the first place, on commencing work, it was found necessary to divert the depleted river from its accustomed course at the foot of the dike, in order that the footings of the new wall could be excavated, and this was accomplished by the construction of a temporary diversion dam above the threatened point and the passing of the water into a previously prepared canal.

This work was all undertaken by General Feng Yu-hsiang, whose soldiers were quartered in the vicinity of Peking, and who allotted some five thousand of them to this task under military supervision but subject to the instructions of the engineering staff of the conservancy board.

The channel was dug in rather less than six weeks, a temporary dam made of wattle piers filled with boulders, fronted with sandbags and backed with earth, was thrown across the old course of the stream, and the construction site was cleared for operations.



General Feng Yu-hsiang's motto "Military Labour will save the Country"

The rock facing is now under course of construction, as shown in the photos some of the stone being carted from the neighboring hills at a cost of about $9 a *fong*, and some of the boulders being taken from the old bed of the river itself.

As can be realized from the photographs, the work had been temporarily reinforced previously, but the lack of foundations had caused a complete subsidence, sandbags, masonry, and wattle work all collapsing together under the extreme pressure of the flood tide of 1922.

In the opinion of the writer this use of troops for constructive work is the most encouraging sign which has been seen in China for several years, and it is to be hoped that other military leaders will follow the patriotic example thus set them by General Feng Yu-hsiang.

As far as the actual construction work is concerned, the diversion canal and dam serve their purpose satisfactorily, as shown in the plan, but it is somewhat unfortunate perhaps that the protecting wall should have been rebuilt in the previous style, as there is no protection for the footings allowed, and in that case a sloping face which will settle gradually and prevent scour is preferable to a vertical wall which has no protection against undermining.

The present scheme, however, should prove suitable to the existing conditions in relieving the immediate danger, and meanwhile the whole question of the Hun Ho (Yung Ting Ho) conservancy work is under the consideration of the Chihli river commission at Tientsin.

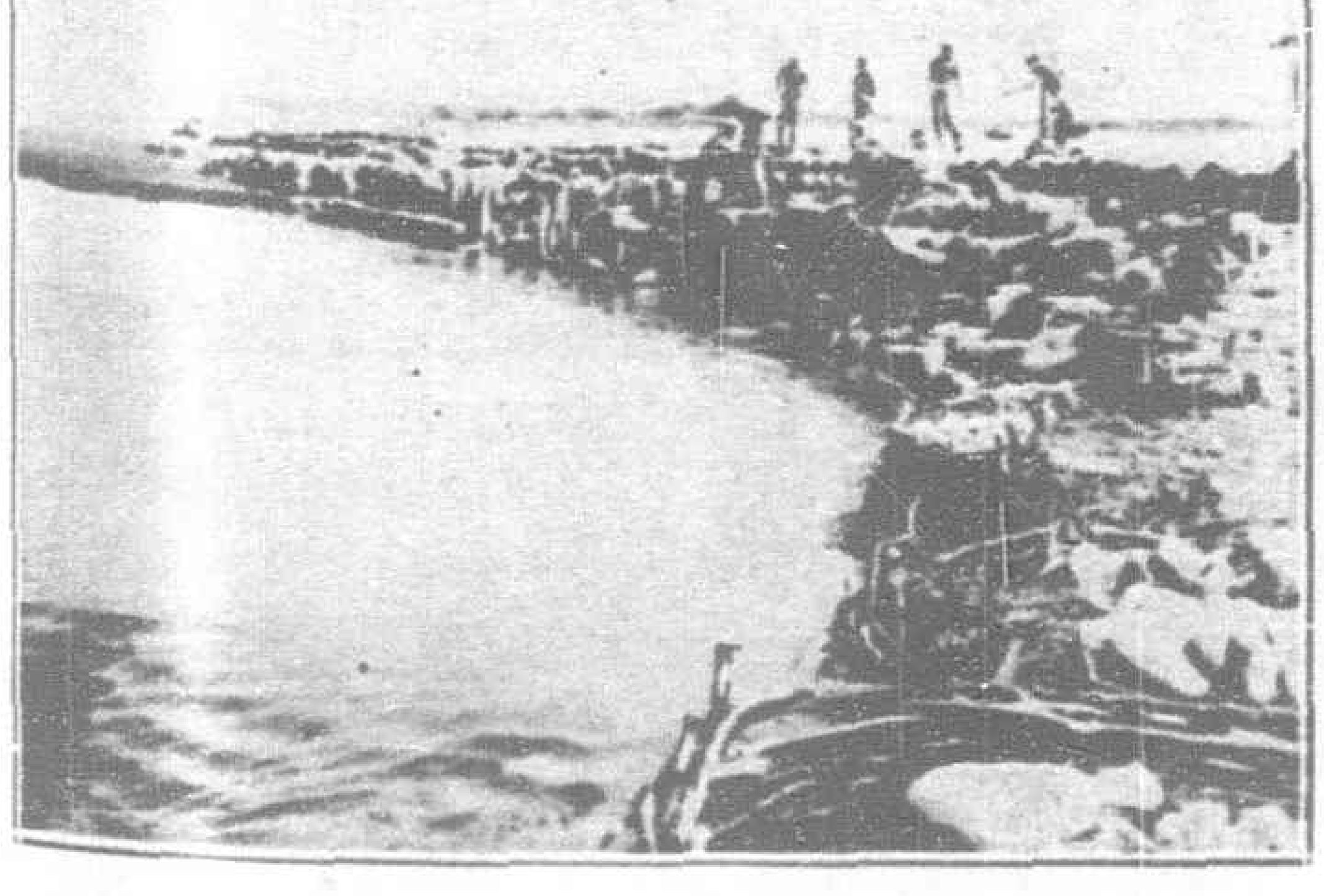
This body has made extensive surveys over the whole area, and has several designs under discussion, though the engineering and executive departments find themselves considerably handicapped by the difficulty of obtaining sufficient funds for their plans in the immediate future.

The scheme which they appear to favor includes the construction of a regulating dam on the Pei Ho and the passing of the water from the Hun Ho into a new channel on the far side of the Pei Ho, thus allowing it to reach the sea without danger of silting up the river approach to Tientsin.

The total cost of this is estimated at $1,500,000 Mex., including the necessary bridges for the Peking-Tientsin railway and road, and it would seem that it is the most economical and soundest scheme available at such reasonable expenditure.

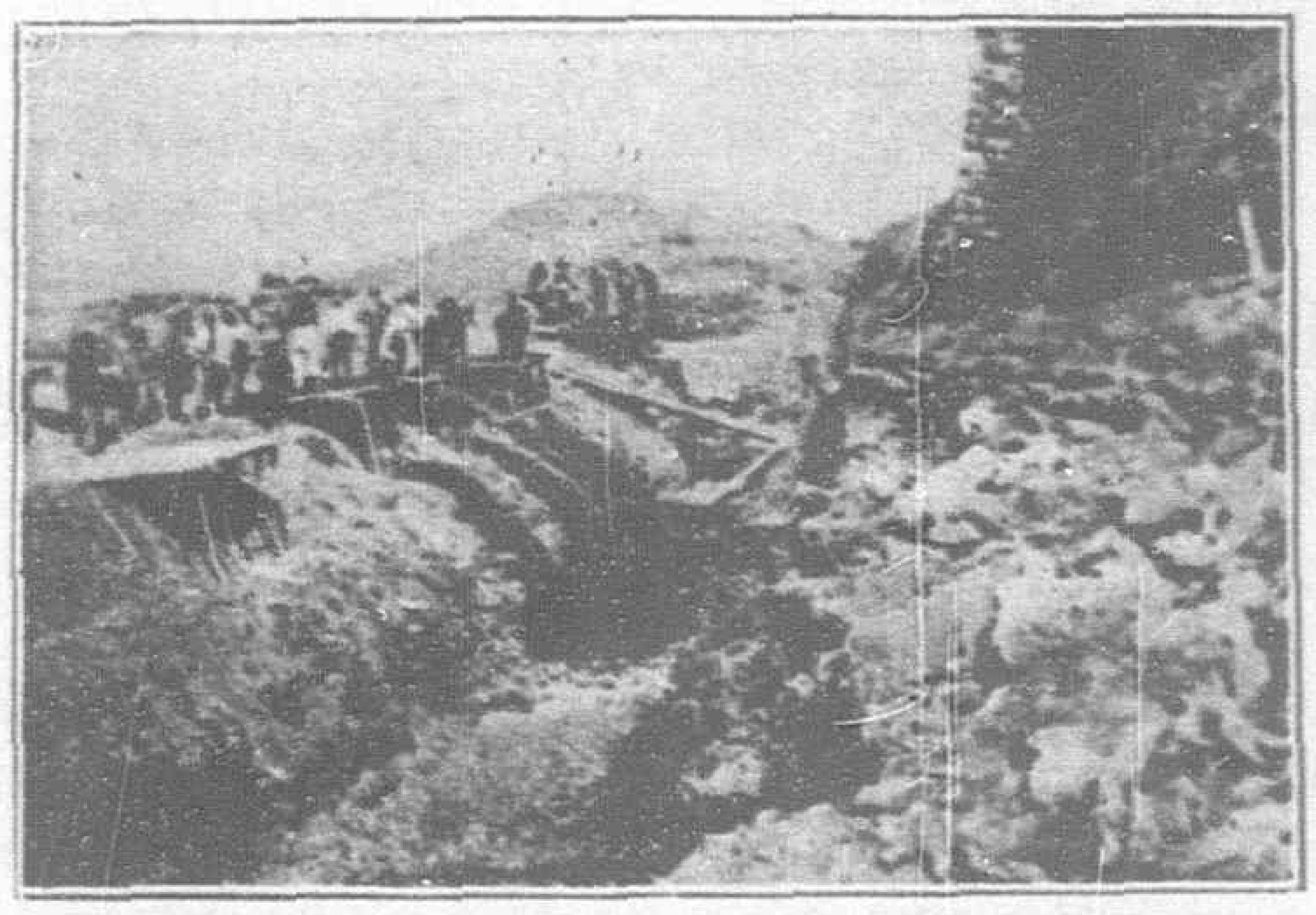
It is also possible that a diversion scheme might be practicable on the upper reaches of the Hun Ho, whereby part of its flow would be directed through a new channel at a point below Mentoukou towards the city of Peking, into whose system of waterways it would eventually flow.

This, while necessitating a far greater expenditure, would greatly benefit the city, which at present suffers greatly through

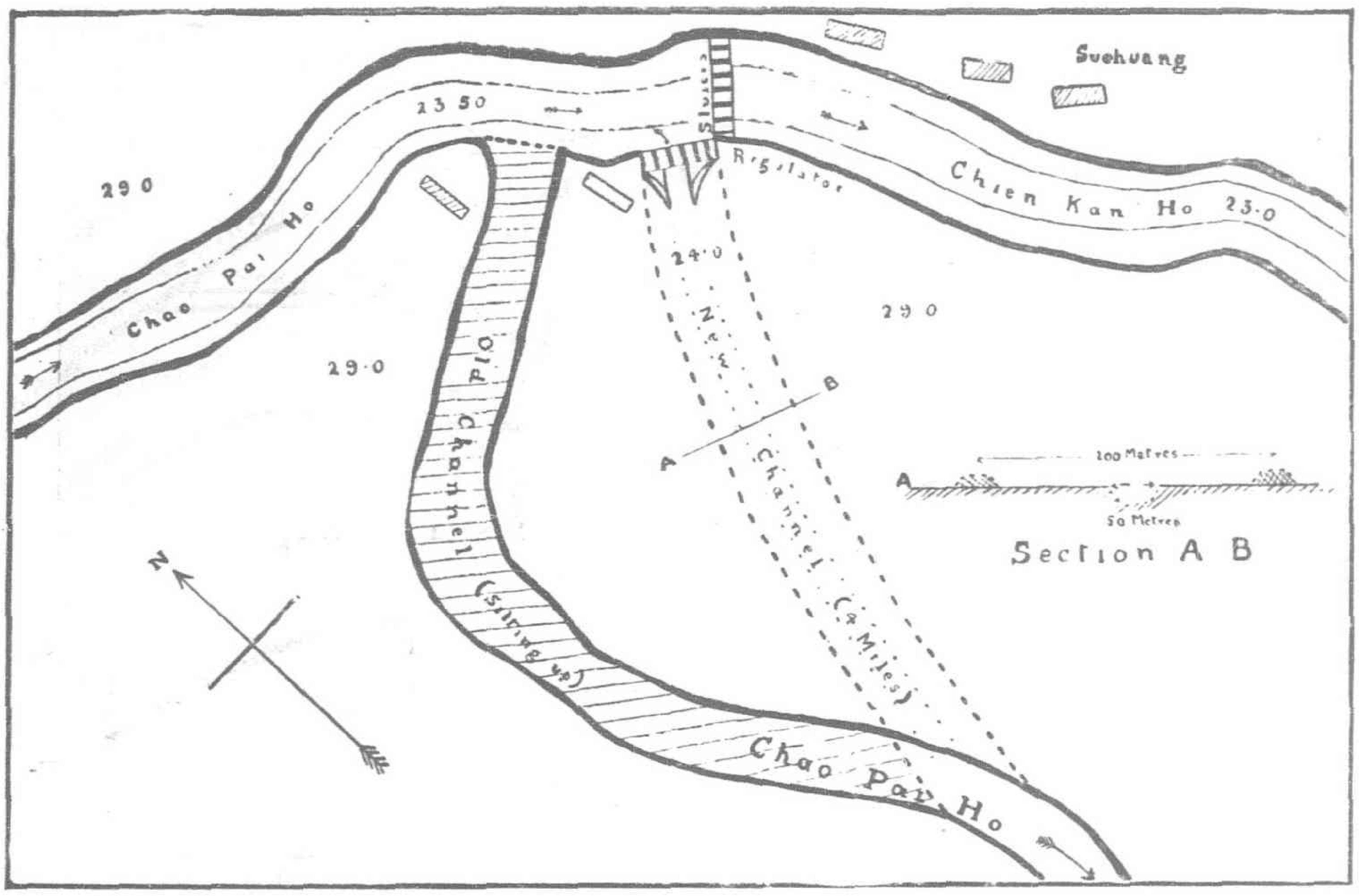


The dam after completion, with the river successfully diverted into its new channel, note the wattle reinforcement and sandbag facing

Working parties engaged on excavating the foundation of the new wall, note that there is no mattress or riprap protection



Working parties mixing and filling in the concrete for the facing of the river wall



Chao Pai Ho Conservancy Work, Suchuang, Chihli Province

lack of water, and it would also rehabilitate the Peking-Tungchow canal, which is now practically disused, but the locks on which could be put in working order at a reasonable cost.

A flood channel might also be provided into the Chiu Ma Ho at a point below Lukouchiao, which would enable the conservancy engineers to handle exceptional floods on the Hun Ho more satisfactorily, besides improving the navigating possibilities of the Ta Ching Ho as far as Paotingfu.

All these projects call for financial assistance, and in the present state of the country it is uncertain as to when and where such help can be obtained; but in view of the fact that, in spite of this difficulty, the Chihli river commission are still carrying on construction schemes it would appear that there is still a possibility of success.

The government is inert or impotent, but the chambers of commerce and the Chinese people themselves are alive to the danger which threatens their prosperity, and are willing to cooperate as far as may be, as has already been evidenced in the carrying out of other schemes in various parts of the country.

The militaristic policy of the *tuchuns* has been and is the chief obstacle in the way of success, and General Feng Yu-hsiang has correctly interpreted the situation in the gigantic Chinese characters which are painted on the river wall of the Hun Ho conservancy work, and which read—"Military Labor will save the Country."

The Suchuang Conservancy Scheme Chao Pai Ho, Chihli, China

Chief Engineer:
Mr. F. C. Rose, C.S.I.
Field Engineer:
Mr. R. D. Goodrich
On behalf of the Commission for the Improvement of the River System of Chihli, China.

It is only within recent years that any definite project has been put forward for the handling of the various problems arising from the rivers of China, rivers which are alike the salvation and the curse of the country.

The salvation, because without them the entire transportation of the empire would fall to pieces and the farmers lose the use of at least one-quarter of their present lands, the curse, because through gross neglect and veniality the rivers are allowed to alter their course and flood vast stretches of arable land throughout the country.

A commission is now formed to consider the conservancy work necessary on the Yangtze, plans have already been put forward for improvements to be executed on the Yellow River, the commission for the Hai Ho at Tientsin was constituted in 1897 and has been functioning ever since, but in spite of these bodies and their best endeavors it must be admitted that little has as yet been accomplished.

Therefore it is the more gratifying to study the work of a body which has only recently come into existence, but which shows every sign of a successful career if one may judge from the work already being put through.

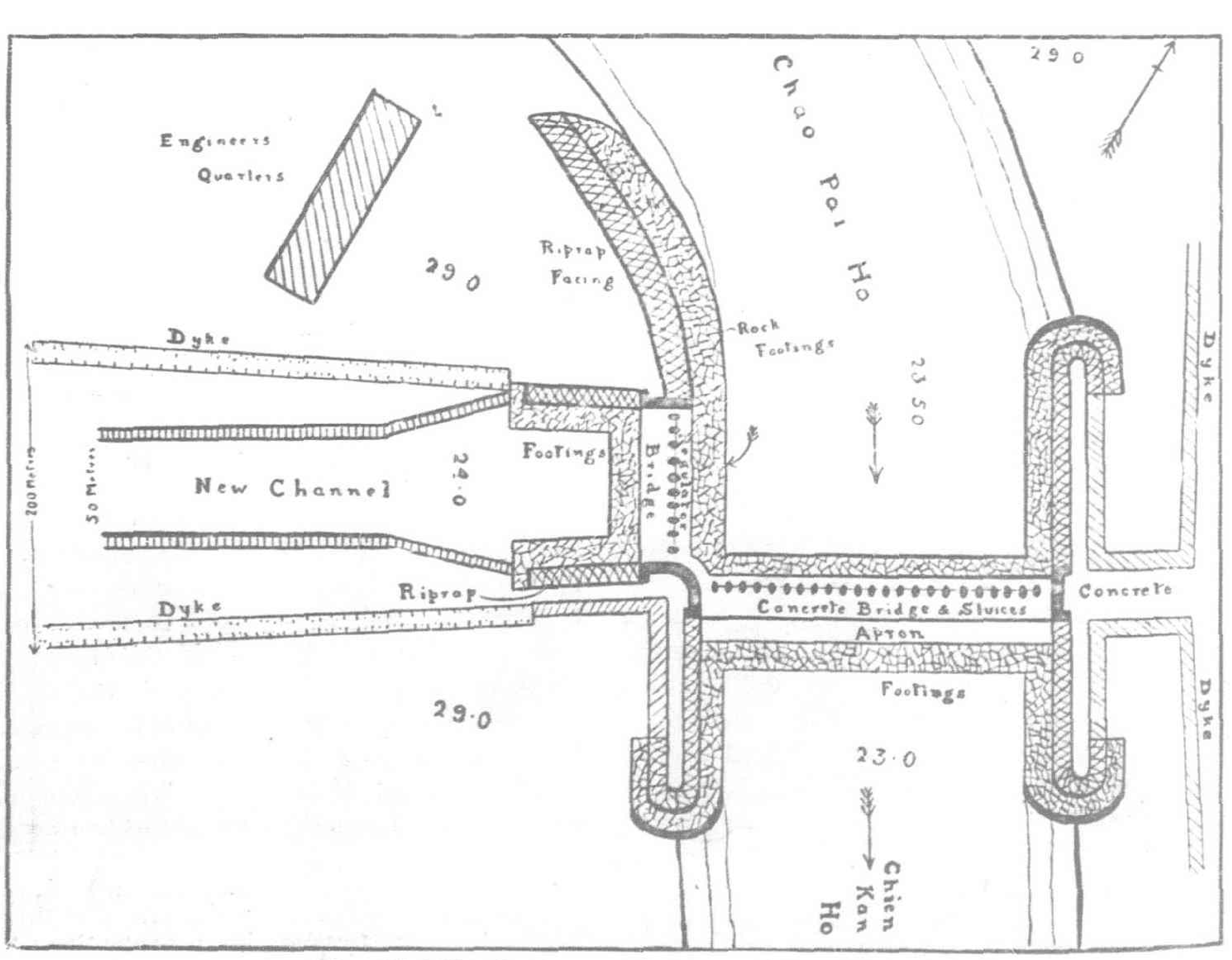
In saying this there is no intention to disparage the work done on other conservancy schemes, it is merely a record of the fact that this particular scheme happened to come under the notice of the writer, and he cannot but express his appreciation of the fact.

The commission for the improvement of the river system of Chihli was formed subsequent to the great floods of 1917, and immediately set about an organized survey of the whole of the area covered by the rivers shown on the accompanying map, a task which is now well on the way to completion.

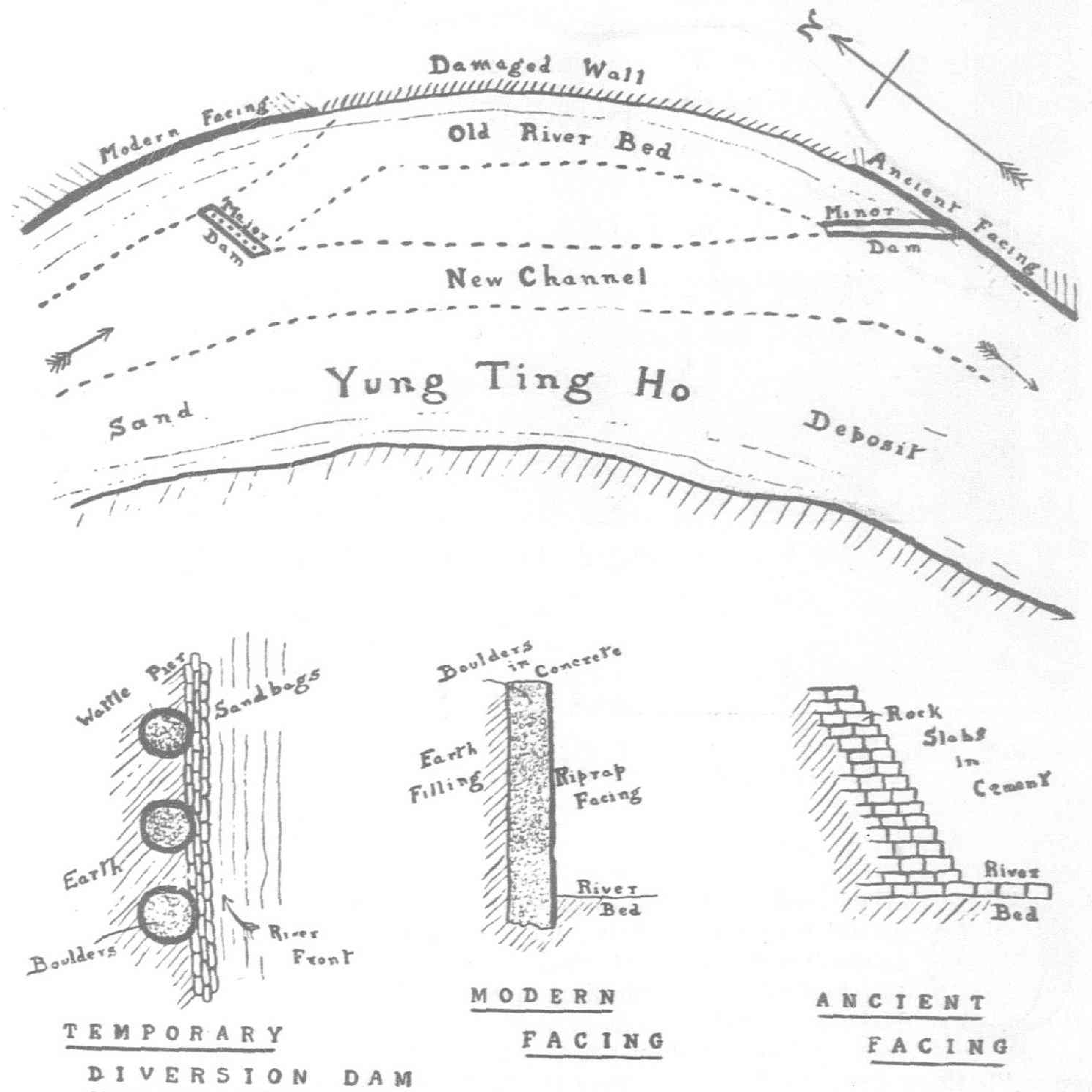
The Hai Ho from Tientsin to the sea had been suffering from an excess of silt deposited in its channel by the Yung Ting Ho and other rivers, and upon investigation it was judged that this was largely due to the fact that in 1912 the Chao Pai Ho, which previously had drained into the Pei Ho and assisted in scouring the channel of that stream and the Hai Ho, had broken its retaining dike and found a way into the channel of the Chien Kan Ho.

This enabled it to flow direct to the sea at a point some distance above the Hai Ho outlet at Taku, and the resultant loss of some 10,000 cubic feet per second in low water rising to as much 105,000 cubic feet per second in flood period caused a large amount of silting, besides lowering the navigating value of the Hai Ho and Pei Ho channels very considerably.

Therefore it was decided that a reversion scheme on the Chao Pai Ho was advisable, and the necessary funds having been obtained, the work would have been commenced in the summer of 1922 if the engineers had not been hindered by the civil war between the Chihli and Fengtien forces during the possible working season before the rains.



Chao Pai Ho, Suchuang Sluices and Regulator



Yung Ting Ho Conservancy: Plan and Details

However, in the spring of 1923 all the arrangements were completed, and the right of way was purchased to enable the construction of the new channel to be commenced.

This is the more worth remarking in that on other construction schemes in China the unfortunate peasant has usually been expropriated by the authorities without due compensation, and from fear on this account the strongest opposition to the scheme had been put forward by the local farmers.

The payment of $180,000 for the land was an unprecedented event in their experience, and immediately overcame any previous objections which they had put forward, for they themselves fully realized the benefit of the proposed conservancy work to their own district, once their dread of expropriation was vanished.

Considerable numbers of these farmers were engaged on sub-contracts to dig and carry the earth from the new channel and to build the dikes required, while others found employment on the stone transportation and riprap work.

The total cost of the new channel was estimated at $200,000, and this appears to be approximately correct now that the work is more than half completed.

The entire scheme may be most easily comprehended by reference to the appended sketch map, whence it will be seen that a dam is to be thrown across the escape into the Chien Kan Ho, thus diverting part of the waters of the wandering Chao Pai Ho into the newly constructed channel leading to its old bed some four miles away.

At the present time the Chao Pai Ho delivers some 110,000 cubic feet per second into the Chien Kan Ho, and it is intended to divert only 20,000 cubic feet of that amount into the new channel, though as that is improved with time it is expected that its capacity will increase to nearly 40,000 cubic feet per second if required.

The sluice across the Chien Kan Ho outlet has a total width of over seven hundred feet, and will contain twenty-eight sluice gates, each twenty feet in width, twenty-three feet in height, and made of 5/16 inch steel plate.

A similar, though smaller, regulator will function for the new channel of the Chao Pai Ho, having a width of about two hundred and twenty feet and containing ten gates of similar proportions to the above.

The total cost of both sets of sluices is estimated at approximately $850,000, while the whole scheme will attain a total of nearly a million and a half dollars Mex. when completed.

The piers for the regulator and the sluice are built of local brick set in concrete, and are twenty-five feet in height, six feet thick, and thirty feet in depth, as illustrated in the photographs of the site.

The riprap facing is on a slope of slightly less that 1 in 1, and is protected at its base by a footing of rockwork in wire cages extending well out into the river bed.

These wire cages are six feet by six feet by three feet, and are built on the spot by skilled workmen brought from Shanghai, at a cost of $4 per cage, which is extremely reasonable considering their value for the work.

Transportation is, of course, one of the chief difficulties, as the steel work comes by ship to Tientsin, as do 18,000 barrels of cement from Hongkong, thence by rail to Tungchow, and so overland fifteen miles by cart, while the rock is quarried in the distant hills and brought down by cart or by native sampan to Suchuang.

It will be noted that the new channel is being constructed with a width of fifty metres only, while the excavated earth is used to build dikes some two hundred metres apart, it being expected that the first flow in the new course will only fill the first named channel, and that it will gradually form its own bed between the two retaining dikes later on.

A time estimate for construction work is always a little difficult, but Mr. Rose hopes that the earth work of the new channel will be completed by August 1923, the regulator by the spring of 1924, and the sluices across the Chien Kan Ho by the spring of 1925, while the riprap and foundation work shown in the photographs will be completed by the autumn of 1923 unless an exceptionally high flood prevents.

The engineering quarters on the west bank are practically finished, and the staff hope to be in occupation by August, after which they will be in constant use, for it will be necessary to leave a resident engineer to supervise the sluices after the work is closed down, both in order that no danger may threaten them and that complete records of flood conditions may be taken on the spot.

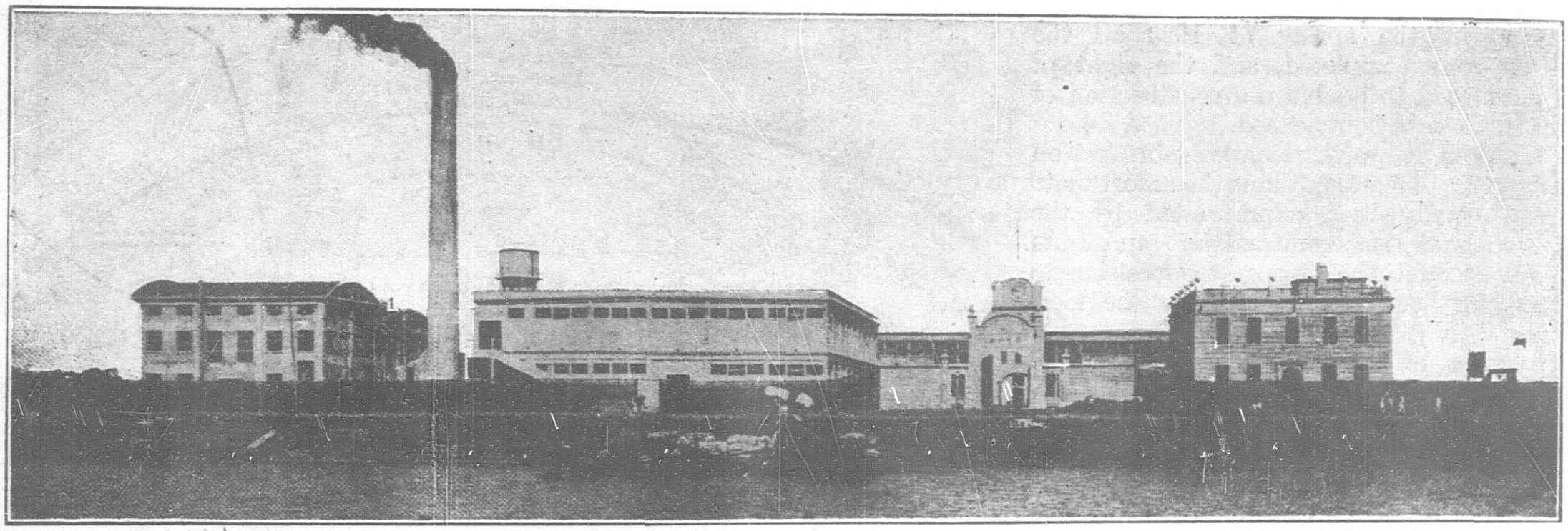
It will be seen from the foregoing summary what an important piece of conservancy work is now going forward at Suchuang, for if it is successful, and there seems no reason to doubt that it will be, it will set an example which will be followed throughout China when in the future the full utility of works of public importance is realized.

The engineering staff of the Chihli River commission is entitled to full credit for the execution of such a piece of work under great difficulties, and it is worth while mentioning here that they have not only this in hand but have now placed before the public further schemes of river improvement entailing an expenditure of an additional five million dollars Mex., which would enormously benefit the greater part of Chihli province, and particularly the important port of Tientsin.

At the same time the writer would like to draw attention to the enormous importance of some scheme of afforestation in connection with these rivers, for while they cover a total area of over eighty-eight thousand square miles, no less than sixty thousand square miles of this is in hilly country, where the importance of vegetation cannot be overestimated as a means of preventing denudation, and the consequent silting up of the beds of the rivers concerned.

China had vast forests in the past, and there is no reason why she should not regain them in the future, providing that the government can be induced to take the requisite steps to promote enterprise in this direction and the people prevented from cutting every available tree for firewood.

(*Continued on page 535*)



The Hua Feng Cotton Mill at Woosung: Designed and Erected by the Wah Chang Trading Co.

China's Cotton Industry.—1

A General Survey of Cotton Production and Manufacturing Industries in China

Theodore Chen, B.A.

"ONE will suffer cold, if a woman does not weave," says an old Chinese proverb. Back even in B.C. 3957, according to our historical records, people were taught the art of spinning and weaving by Mih Hsi Sze. For thousands of years, however, weaving was carried on but only in the "individual handcraft system." Even down to the last days of the Manchu dynasty, the art had been improved only to such an extent as " household handcraft system." Not until during the reign of Kwang Hsü, when machine spun cotton yarn was first imported into China from India, did a few farsighted Chinese begin to realize the importance of the modern method of cotton manufacturing and deem indispensable the establishment of modern cotton spinning and weaving mills. Within a period of only three decades (1890-1923) the cotton manufacturing industry in a modern sense has grown up in China from the zero mark to 120 mills with 3,550,108 spindles and 27,514 looms.

Progress in cotton cultivation is marked with the same degree. Although cotton raising has been carried on very extensively for centuries by the Chinese farmers, the average production has nevertheless, only been sufficient for household handcraft spinning and weaving and to fill the needs of bed-coverings and winter clothes. As a matter of fact, the production of cotton has not been encouraged to any great degree and consequently no special effort has been put forth by the people. The recent rapid growth in the number of mills and the increasing consumption of raw cotton have made cotton raising a very profitable pursuit for the farmers. The mill owners on the other hand have also encouraged the output of raw cotton for their own end ; and have thus stimulated much the increased production of cotton in China. In 1918, it was reported that more than 31 million *mow* of land was under cultivation with a total yield of 10,965,530 piculs of cotton. It would be easy for China to extend her cotton acreage to 150 million *mow* with a yield of 40 million piculs.

There is every evidence to prove that China is the most hopeful country of the world in the cotton manufacturing industry. The present is only the beginning of what will be a greater and more rapid development in the near future. The market is ready for the consumption of whatever the mills can turn out, labor is cheap and abundant for full operation of mills and raw cotton will be available for the full running of the mills. China's cotton manufacturing industry, therefore, offers an interesting subject for study in both its agricultural and its manufacturing phases. Its tremendous potentialities and possibilities in the future and its marked success and development in the past years have drawn much attention not only from the Chinese but from the foreigners as well.

1. Cotton Production in China

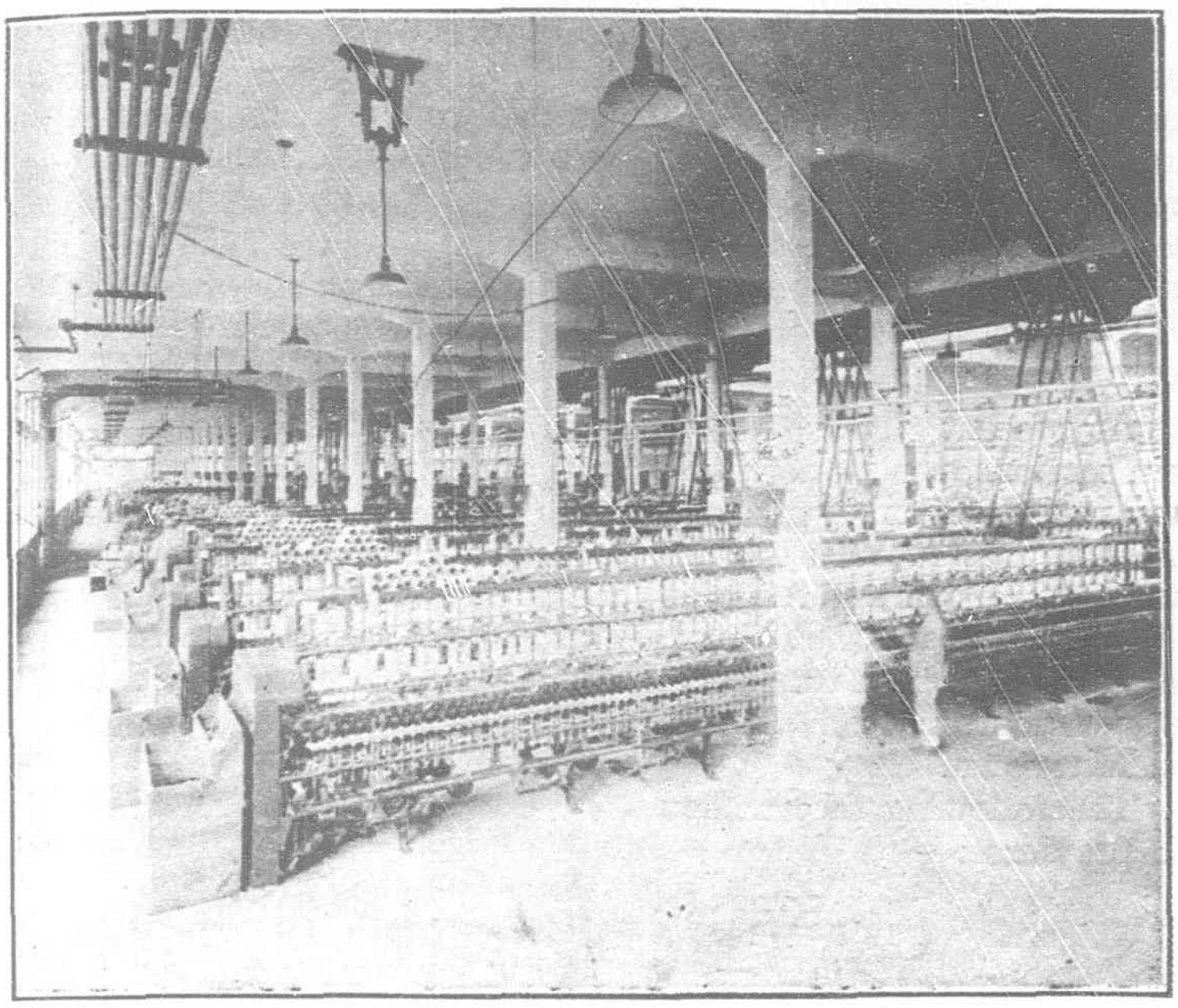
Although there is a lack of accurate statistics, it is generally supposed that China ranks third in the world's production of cotton with an annual output of two million bales (four piculs per bale), India being second with four million bales and America first with an annual yield of fourteen million bales. It must be admitted that very scant care has been given to cotton cultivation in China. Only recently have Chinese cotton merchants been encouraging the cotton growers to improve the quality of their product and to increase the quantity thereof. Experimental work in the introduction of American seeds and the improvement of native crops are being carried on very effectively by the Chinese cotton mill owners' association, the ministry of agriculture and commerce and the missionary educational institutions. According to the latest investigation, there were in China more than 31 million *mow* of land under cultivation with a yield of more than ten million piculs of cotton in 1918. As a result of flood in the Yangtze Valley, the 1919 cotton crop was greatly decreased to only 9,316,390 piculs. In 1920, there were not only floods in Kiangsu and Chekiang provinces, but also drought in the north, the cotton crop was, therefore, again decreased to only about seven million piculs.

The following figures will show the general trend of cotton production in China from 1918, the crown year of production to 1922, the year of slight recovery :—

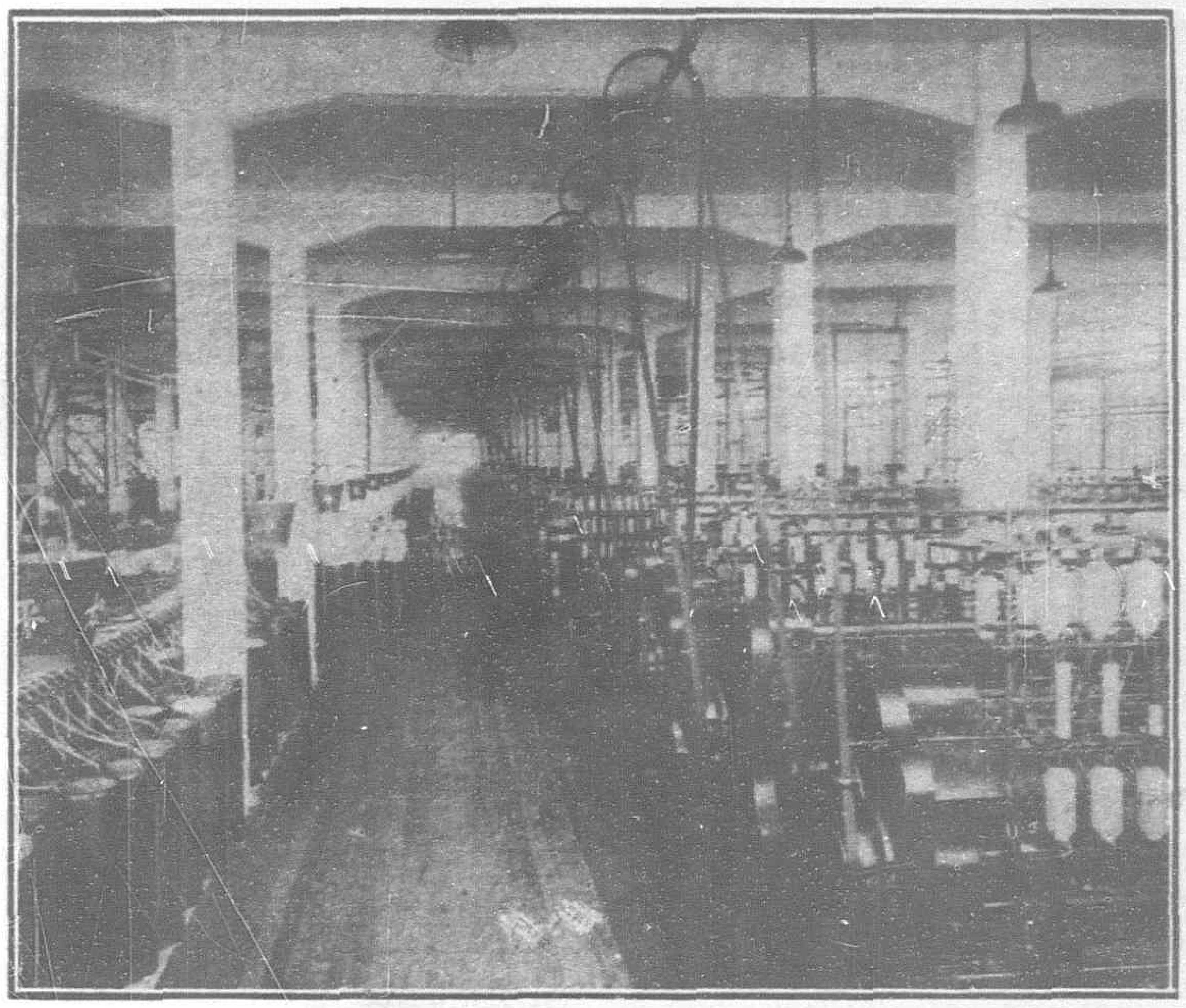
1918	10,965,530 piculs
1919	9,316,390 ,,
1920	6,750,000 ,,
1921	5,438,000 ,,
1922	7,342,000 ,,

The average production within the five years as above stated is over 7,962,000 piculs. Suppose each spindle consumes 350 catties of cotton, and out of 3,550,108 spindles, if 2,200,000 are in full operation, then the yearly consumption of cotton in China will be 7,700,000 piculs. When all the spindles are in full operation 12,425,000 piculs will be required. Furthermore, about four-tenths of cotton production in China are used for filling bed-coverings and winter clothes, so out of the average production of 7,962,000, only 4,776,000 piculs are actually consumed by the cotton mills.

Year after year, China's cotton crop has been greatly affected by flood, drought and other unfavorable conditions. This, however, is only temporary. Investigation shows that the province of Chihli in 1921 leads in cotton production with a yield of 1,819,314 piculs, an increase of 800,000 piculs over the previous year ; followed by Kiangsu, 1,283,660 piculs ; Hupeh 615,150 piculs ; Shensi 429,967 piculs ; Chekiang 308,760 piculs ; Shangtung 304,077 piculs ; Shansi 248,737 piculs ; Hunan 219,400 piculs ; Anhwei 163,830 piculs ;



The Hua Feng Cotton Mill, Woosung, Spinning Machines: Designed and Erected by the Wah Chang Trading Corporation, Shanghai



The Hua Feng Cotton Mill, Woosung, Roving Frames: Designed and Erected by the Wah Chang Trading Corporation, Shanghai

and Kiangsi 45,325 piculs ; with a total of 5,348,220 piculs, 1,312,183 piculs less than 1920.

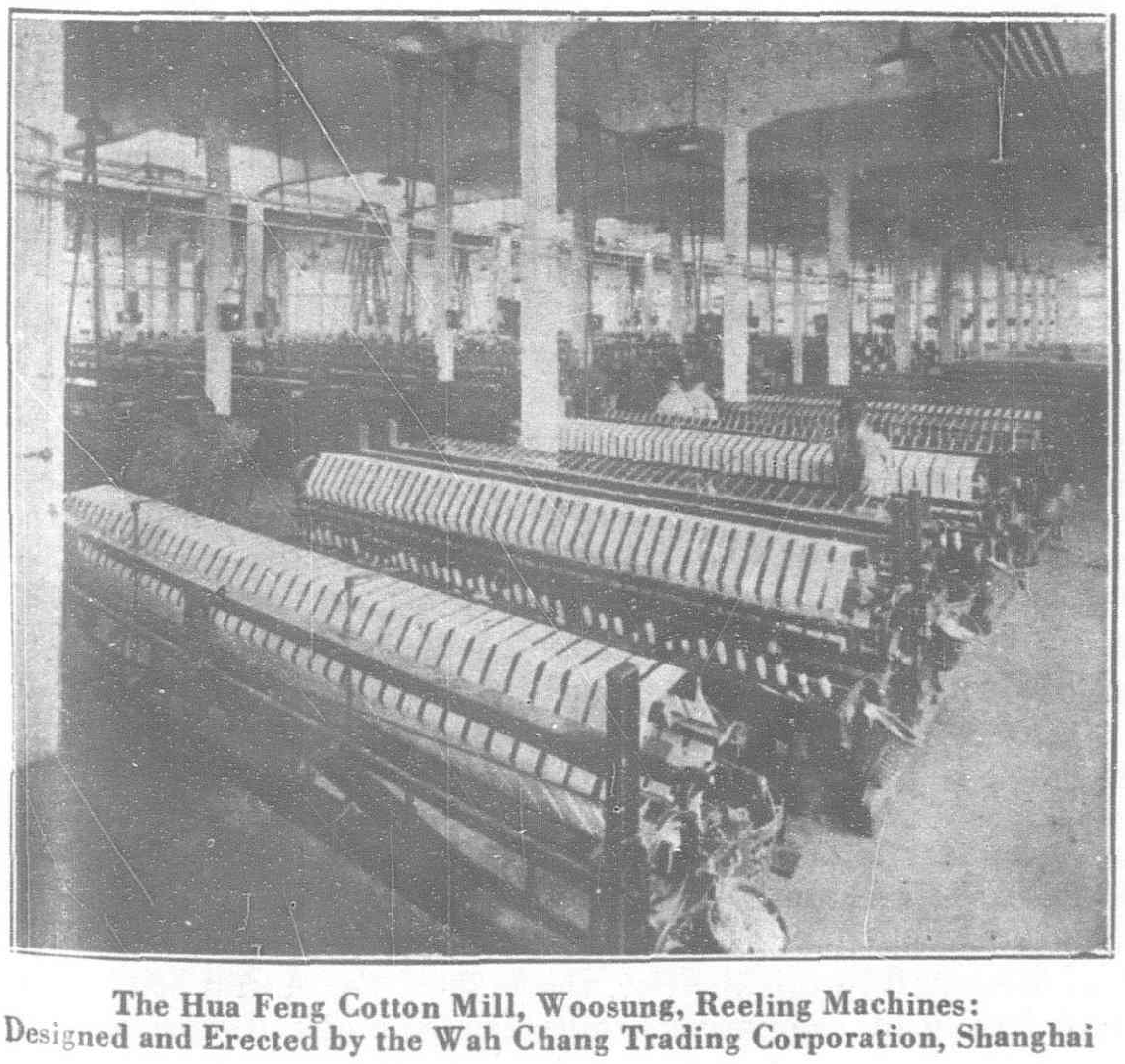
The cotton belts of Huang Ho (Yellow River) Valley scored a great success in growing American seeds, on account of its favorable climate and soil. Accordingly, Shensi produced 428,043 piculs of American cotton, followed by Shansi 104,880 ; Honan 49,800 ; Shangtung 11,768 and Chihli 10,488 ; with a total of 604,979 piculs. In the Yangtze Valley, it has not met with much success.

The following table shows cotton production in the ten leading provinces from 1919 to 1921 :—

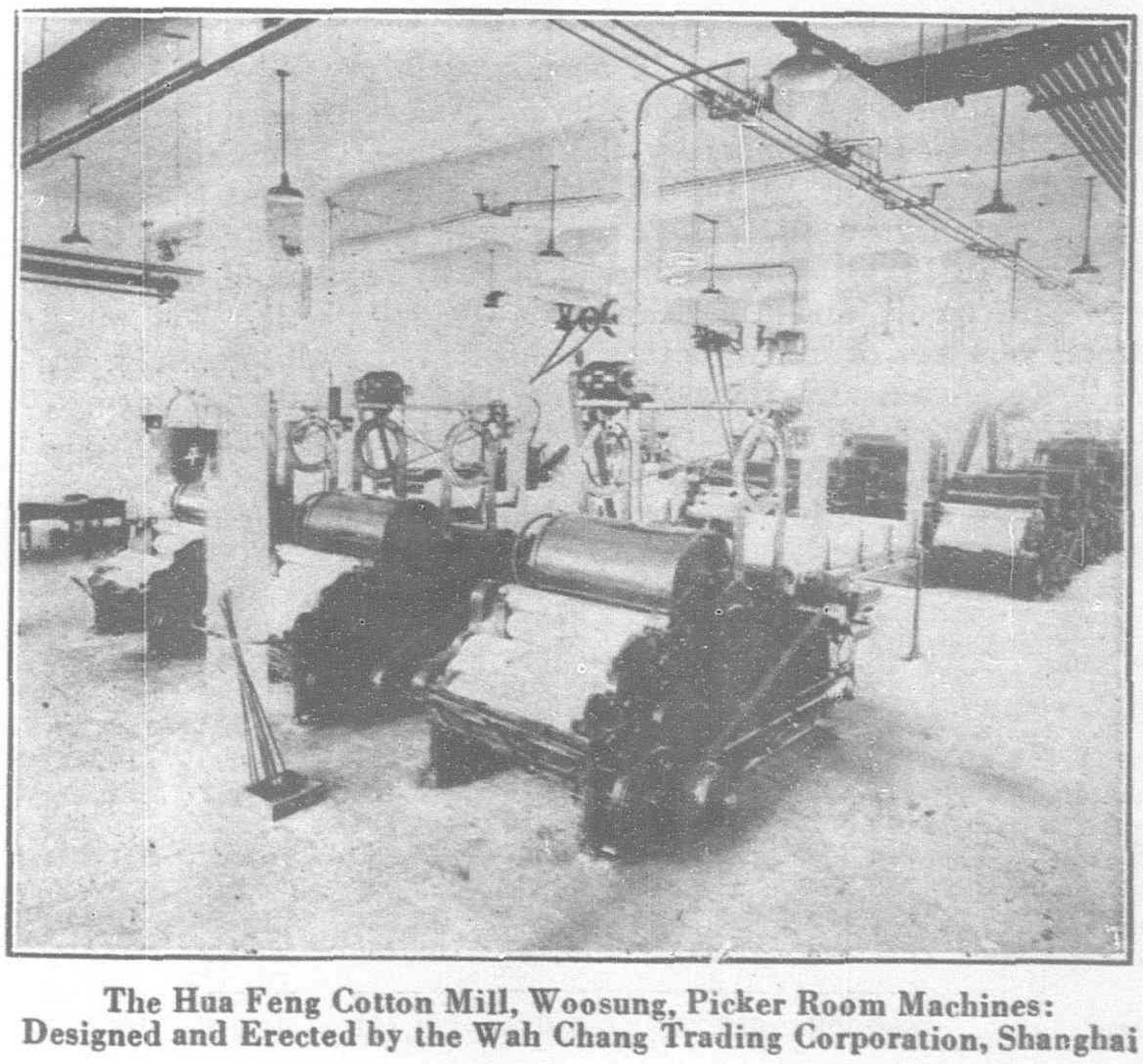
	ACREAGE (in *mow*)			PRODUCTION (in picul)		
Province	1919	1920	1921	1919	1920	1921
Chihli ...	6,397,000	4,391,032	4,709,963	2,683,753	1,022,219	1,819,314
Shangtung	3,218,000	428,330	2,333,190	894,558	126,070	304,077
Shansi ...	486,320	615,240	695,025	201,851	64,996	248,737
Honan ...	1,417,654	—	856,000	427,633	—	219,400
Shensi ...	—	1,283,650	2,405,910	643,000	293,967	429,967
Kiangsu ...	19,278,307	12,474,700	11,812,600	2,763,160	3,022,210	1,283,660
Chekiang ...	—	1,270,100	1,199,000	264,900	251,106	308,760
Anhwei ...	762,600	1,195,695	1,099,000	125,535	291,975	163,830
Kiangsi ...	—	398,850	256,650	105,000	97,860	45,325
Hupeh ...	—	6,269,700	2,849,100	1,207,000	1,580,000	615,150
Total ...	31,559,881	28,327,297	28,216,438	9,316,390	6,750,403	5,438,220

1. *Chihli Provinces.*—Cotton in this province is mostly produced in the southern part. The annual production of cotton in Sungchih amounts to over 400,000 catties and in Chinghsien 6,000,000 catties, covering an area of more than 120,000 *mow*. While in Chingting cotton cultivation is the principal occupation of the people. There are more than 208 villages in the district where nearly every farmer devotes eight-tenths of his land to cotton crop. The price for raw cotton was only 7-cts. per catty before the completion of the Peking-Hankow Railway, which has not only raised the price but also encouraged more production of cotton. On account of its vast tract of land devoted to cotton cultivation, Chingting has to depend on Shansi and other near-by provinces for food supply.

There were 4,709,963 *mow* of land in Chihli under cotton cultivation in 1921, an increase of 300,000 *mow* over the previous year. The total yield of the same year was 1,819,314 piculs, an increase of 800,000 piculs. Both the soil and climate of Chihli are ideal for cotton raising. There are many species of cotton seeds, such as grand white, small black, long and short fibres, etc. Wuchih district produces the best quality. American seeds are grown very successfully in the districts of Wuchih, Shenfoong, Yuohlien, etc. Trice is the most common specie grown. The total output of American seed was estimated at 10,488 piculs in 1921.



The Hua Feng Cotton Mill, Woosung, Reeling Machines: Designed and Erected by the Wah Chang Trading Corporation, Shanghai



The Hua Feng Cotton Mill, Woosung, Picker Room Machines: Designed and Erected by the Wah Chang Trading Corporation, Shanghai

Tientsin is by far the most important cotton mart of this province with Shichiaochuan second in importance, both being situated on railway lines.

The following table shows its principal producing centres with amounts of production and acreage under cultivation from 1919-1921 :—

Districts	Acreage (in *mow*) 1919	1920	1921	Production (in picul) 1919	1920	1921
Chaocheng	500,000	540,000	391,000	209,000	111,500	156,100
Yunnien ...	368,000	110,000	364,500	100,096	19,300	116,680
Chingting ...	300,000	32,000	387,000	120,000	65,000	159,320
Wuchih ...	810,000	85,000	90,950	20,381	2,024	38,194
Kaocheng	1,166,000	345,000	512,550	521,574	110,400	264,030
Chinhien ...	580,000	422,000	462,300	324,220	151,920	166,300
Sungchih ...	120,000	110,000	220,000	51,440	36,000	79,200
Foongshun	277,000	305,000	30,000	118,833	55,000	4,750
Yuohdien ...	125,000	120,000	20,500	57,420	25,000	7,200
Other districts...	2,151,000	2,322,032	2,231,163	1,160,789	446,075	827,540
Total ...	6,397,000	4,391,032	4,709,963	2,683,753	1,022,219	1,819,314

2. *Shantung Province.*—Both native and American cotton are very well grown in practically every part of Shantung. American seeds are grown very successfully especially in Tang-ih, Kuan-dao, Kao-tang, Tsing-ping, Hai-fong, etc. Shanghsien, Lingtsing, Kao-tang and Hsia-ching are the chief collecting centres where about 130,000,000 catties are shipped annually. Cotton is the second important crop of this province (first being peanut). Tsingtao was formerly the principal outlet for Shangtung cotton to other provinces and abroad.

Owing to the drought in the first part and heavy rain in the latter part of the year of 1921, a distinct reduction in cotton production was felt. The crop of American seeds, however, was far better than the native. The yield of the former was over 11,000 piculs. The most common varieties of native cotton are purple, long and short fibres, green stalk and silky, etc. Trice is the only American seed that has been grown with marked success. Cotton is first shipped to Tsinan and thence to Hankow or Tientsin, after the supply has been taken by the local people for filling bed-coverings and winter clothes.

The following table shows the leading producing centres of this province :—

Districts	Acreage (in *mow*) 1919	1920	1921	Production (in picul) 1919	1920	1921
Kaotang ...	240,000	20,000	120,600	35,000	1,000	15,150
Litsin ...	260,000	6,000	—	50,000	6,000	—
Pinghsien ...	250,000	2,500	150,000	105,000	250	4,000
Weiming ...	347,000	700	55,000	10,850	110	7,015
Tsingping ...	450,000	—	101,000	129,600	—	11,250
Hsiatsin ...	400,000	—	206,000	129,600	—	41,500
Lingtsing ...	240,000	—	402,000	80,000	—	60,400
Tangih ...	160,000	—	280,000	51,840	—	32,000
Kwantao ...	220,000	—	158,600	41,250	—	20,000
Other districts	651,000	399,130	880,590	261,418	118,710	127,912
Total ...	3,218,000	428,330	2,333,190	894,558	126,070	304,070

3. *Shansi Province.*—Although not a famous producing province, cotton cultivation has been greatly encouraged by the officials of Shansi. A large quantity of American seeds was distributed free to the farmers by the governmental bureau. With the excellent yield of 1918-1919, farmers then realized the great profit in cotton growing. There were more than 695,000 *mow* of cotton land in 1921. The total yield of native cotton of that year was 248,737 piculs, and American seeds 104,880 piculs. The most common varieties of native cotton are soft, red stalk, green stalk, etc. Trice, Acala and Kings, etc. are the most common grown American seeds. All the surplus cotton (about 90,000 piculs) is exported to Tientsin and Hankow.

The following table shows the leading producing centres of this province :—

Districts	Acreage (in *mow*) 1919	1920	1921	Production (in picul) 1919	1920	1921
Hongtung ...	40,500	45,148	63,994	24,300	12,189	22,520
Lingfeng ...	37,840	43,000	43,895	20,701	11,180	13,900
Hotsin ...	41,128	52,677	54,000	19,740	5,795	17,200
Yungho ...	43,529	61,966	35,693	25,591	6,596	10,000
Lingchin ...	44,182	57,230	13,076	16,420	572	12,200
Yungtsi ...	40,352	43,260	151,216	14,123	556	72,300
Yuhsiang ...	43,703	56,233	44,897	15,839	3,362	11,300
Chiahsien ...	38,355	62,420	45,135	13,040	248	8,960
Chüoh ...	32,474	39,463	32,642	13,639	1,578	12,820
Other districts	224,257	143,843	210,497	38,458	22,922	67,537
Total ...	486,320	615,240	695,025	201,851	64,996	248,737

4. *Honan Province.*—Cotton is quite extensively cultivated in this province, especially in the districts of Hwai-yang, Hsu-chong, Shang-chiu, and Kwei-teh, etc. American seeds are grown very successfully between Shenhsien and Lingpaohsien. The yield of native cotton is placed at 1,000,000 catties. The bulk of this amount goes to Cheng-teh Spinning and Weaving Co., the surplus being sent to Tientsin or Hankow, Hwang-ho is the chief waterway for the transportation of cotton to Changteh and Chengchow. Cotton grown in Loyang district is of very inferior quality.

At present, the cotton producing belts are divided into two main sections, the western and northern. In the northern section more native cotton is produced while in the western section more American cotton. The 1921 yield of native cotton in both sections was 169,600 piculs and American cotton 49,800 piculs. Chengchow at the cross road of Peking-Hankow and Lung-Hai Railways is the centre of cotton transportation. It handles about one million piculs of cotton from Shansi, Shensi and Shangtung provinces besides its own.

The following tables shows the leading producing centres of this province :—

Districts	Acreage (in *mow*) 1919	1920	1921	Production (in picul) 1919	1920	1921
Hsinhsiang ...	72,575	—	21,000	25,976	—	6,000
Wuan ...	65,671	—	57,000	20,946	—	14,000
Lingchang ...	69,358	—	56,000	23,517	—	13,000
Anyang ...	102,866	—	84,000	31,918	—	28,000
Shenhsien ...	85,000	—	92,000	35,500	—	24,000
Lingpao ...	111,743	—	120,000	33,522	—	32,000
Venhsiang ...	111,579	—	103,000	35,216	—	29,500
Yensze ...	125,869	—	70,000	37,760	—	16,000
Szeshui ...	99,228	—	25,000	29,768	—	5,000
Other districts	573,715	—	228,000	143,510	—	51,900
Total ...	1,417,654	—	856,000	427,633	—	219,400

5. *Shensi Province.*—Cotton is very extensively raised, due to the ideal climate. American seeds are also grown very successfully. Its principal cotton belt is the Wei-ho Valley. In 1919 the yield amounted to 643,000 piculs, but in 1921 it was decreased to 429,967 piculs. Shensi lacks good transportation facilities. Cotton is shipped to Chengchow and Hankow by way of Sze-shiu and Wei-ho and the Lo-dong Railway. The transportation fee at present averages at Tls. 14 per bale.

The following table shows the leading producing centres in this province :—

Districts	Acreage (in *mow*) 1919	1920	1921	Production (in picul) 1919	1920	1921
Hwaying ...	—	240,000	74,000	73,000	40,000	13,500
Hwahsien ...	—	133,300	185,500	50,000	12,000	52,700
Weinan ...	—	242,000	216,900	130,000	40,000	61,430
Lingdong ...	—	200,000	194,830	39,000	27,000	32,907
Yenyang ...	—	80,000	129,200	23,000	13,000	33,980
Changan ...	—	263,700	299,500	—	87,600	93,818
Sanyuen ...	—	89,000	154,800	—	14,700	38,559
Kaoling ...	—	—	163,200	—	35,450	46,450
Kayang ...	—	—	8,060	—	982	1,332
Other districts	—	35,650	989,820	—	23,235	55,291
Total ...	—	1,283,650	2,405,910	—	293,967	429,967

9. *Kiangsu Province.*—Kiangsu is by far the most important cotton producing province as well as cotton manufacturing centre of China. Cotton ranks second in importance to rice, the only principal staple product in China. Cotton is produced nearly everywhere in this province, especially in the six districts of Tungchow, Taichang, Kaiting, Changshuh, Shanghai and Changyinsha. In Tungchow district nearly six or seven-tenths of the land are devoted to cotton cultivation. This district comprises Nantung, Tsungming, Haimen, etc., covering an area of more than 300 *li* east to west and 150 *li* north to south. This is also the leading cotton producing section not only of this province but also of China as a whole. Average production is about 1,500,000 piculs. The Ta Sung Mills at Nantung and Tsungming consume the bulk of the production and the surplus is shipped to Shanghai.

The Shanghai district comprises Paoshan, Chuensha, Nanwei, Fengyen, Sunkiang, Kingshan and Pinghu (of Chekiang province). It ranks second only to Tungchow in area. Its average annual production is estimated at about 800,000 piculs. Besides supplying the local mills, it has a surplus usually shipped to Japan.

Kaiting district produces about 140,000 piculs annually. There is no mill in this district, the bulk of the cotton being consumed locally by the native handcraft spinning and weaving, the rest being exported to Shanghai, Soochow, Wusih, etc.

Taichang district produces about 250,000 piculs annually for the consumption of Tsi Tai and Yue Tai Mills, surplus being exported to Shanghai, Soochow, Wusih, etc.

Changshuh district produces about 150,000 piculs annually. It also supplies its bulk to Tsi Tai and Yue Tai mills and native crafts, all the surplus being exported to Shanghai, Soochow, Wusih, etc.

Changyinsha district lies along the middle section of Yangtze Valley comprising an area of about 20 *li* east to west and 8 *li* north to south. Its annual average production ranges from 60,000 to 70,000 piculs. The Li Yung Mill of Kiangyin and the native crafts consume nearly its entire production.

In 1918 the yield of cotton in the whole province amounted to 4,128,696 piculs. The flood, however, reduced the yield to only 1,283,660 piculs in 1921, being only one-fourth of the production of 1918. This province not only produces a large quantity of cotton but also a much better quality than any other province. Shanghai, located at the mouth of the Yangtze, is the greatest cotton market as well as cotton manufacturing centre in China. Cotton produced in Hupeh, Shensi, Kiangsi and Anhwei provinces is also shipped to Shanghai.

The following table shows the leading producing centres of this province :—

	ACREAGE (in *mow*)			PRODUCTION (in picul)		
Districts	1919	1920	1921	1919	1920	1921
Nantung ...	7,582,300	5,000,000	5,200,000	1,500,000	1,030,000	56,000
Haimen ...	2,600,000	1,600,000	1,600,000	211,640	380,000	130,000
Tsungming	1,200,000	1,200,000	1,210,000	200,000	370,000	108,000
Taihsin ...	3,225,600	190,000	100,000	220,000	22,500	5,000
Hsukao ...	1,666,407	864,000	963,600	204,000	215,000	134,000
Tungtai ...	200,000	320,000	180,000	66,000	70,700	—
Kiangyin	140,000	180,000	380,000	35,000	63,270	25,200
Changsuh ...	410,000	400,000	350,000	55,000	153,000	41,040
Taichang ...	300,000	350,000	300,000	30,000	100,800	54,250
Kaiting ...	300,000	300,000	150,000	24,000	75,600	54,000
Shanghai ...	110,000	100,000	150,000	40,000	29,440	20,400
Paoshan ...	150,000	150,000	740,009	15,000	50,000	18,500
Nanhwei ...	785,000	750,000	350,000	140,000	198,000	85,470
Fengyer ...	423,000	400,000	100,000	80,000	100,800	32,600
Chuensha ...	120,000	150,000	—	25,920	54,000	14,000
Other districts	66,000	520,700	39,000	16,600	109,200	505,200
Total ...	19,278,307	12,474,700	11,812,600	2,763,160	3,022,210	1,283,660

The export and import of raw cotton from this province really deserves some attention. The actual amount of cotton exported from the interior parts of this province can hardly be ascertained on account of a lack of accurate statistics. According to the Customs Report, no export of cotton from Nanking is indicated and those exported through Chinkiang and Soochow are very small. Shanghai is the only port where cotton is exported in bulk. The total export in 1913 was 238,802 piculs, 254,433 in 1914, 138,767 in 1915, 199,827 in 1916 and 335,898 piculs valued at Hk. Tls. 689,681 were exported abroad and 32,118 piculs valued at Hk. Tls. 830,892 were exported to other parts of China in 1916. The above figures indicate only the cotton produced in this province and exported directly from Shanghai. In 1916 cotton shipped from the interior parts of China to Shanghai and thence re-exported abroad were 437,575 piculs valued at Hk. Tls. 9,714,165 and to other parts of China were 38,105 piculs valued at Hk. Tls. 845,931. Then there was also cotton shipped from abroad and re-exported from Shanghai to other parts of China, about 14,617 piculs valued at Hk. Tls. 320,113. The total amount of cotton exported from the port of Shanghai is approximately 858,313 piculs in 1916.

The export to Japan constitutes about eight or nine-tenths and the rest goes to the United States, Great Britain, France, Germany and other European countries.

The import of cotton into Shanghai from abroad was 272,142 piculs valued at Hk. Tls. 959,910 in 1912. Besides those re-exported to other ports, the net import into Shanghai was 257,525 piculs valued at Hk. Tls. 5,639,797. The import in 1913 was 107,186 piculs, 95,780 in 1914, 324,506 in 1915 and 383,437 in 1916. Shanghai also imported from Ningpo, Hankow, Shensi, Tientsin, etc., to the amount of 1,089,453 piculs in 1917. Beside those re-exported, the net import from those ports was 613,773 piculs and also imported through native customs 175,988 piculs, making the total import in 1917 approximately 1,047,286 piculs.

The import is chiefly from the United States and India. Because of its longer and finer fibres, American cotton is indispensable in spinning fine grade yarn, so it constitutes nearly two-third of the total import.

7. Chekiang Province.—The condition of cotton cultivation in this province is somewhat similar to Kiangsu. Being third in importance among the agricultural products (the first being silk and second tea), production is therefore not so prosperous as in its neighboring province, Kiangsu. Much attention, however, has been given recently to its cultivation. It is estimated that the best yield so far has been about ten million piculs. Hsiao-Lu-Chin, a very small town, is especially noted for its quantity production of over 200,000 piculs annually. There are abont 1,199,000 *mow* of land under cultivation with a yield of 308,760 piculs in 1921, being the poorest production so far, on account of the flood.

The following table shows the leading producing centres of this province :—

	ACREAGE (in *mow*)			PRODUCTION (in picul)		
Districts	1919	1920	1921	1919	1920	1921
Pinghu ...	—	143,700	132,000	24,000	27,250	32,760
Haining ...	—	43,400	41,000	17,500	6,600	8,660
Siaoshan ...	—	275,700	270,000	24,000	69,716	89,100
Shaohsing ...	—	216,000	200,000	70,000	55,460	57,600
Yuyao ...	—	444,000	400,000	82,000	74,690	80,000
Tsechi ...	—	94,100	90,000	20,000	15,610	18,000
Shangyu ...	—	42,000	50,000	20,000	9,820	20,000
Chinghai ...	—	12,600	16,000	7,000	1,860	2,640
Ningpo ...	—	600	—	400	100	—
Total ...	—	1,270,100	1,199,000	264,900	251,106	308,760

8. Anhwei Province.—Although not an important cotton-producing province, Anhwei yielded about 163,830 piculs in 1921. The quality is very poor. The bulk of production is exported to Anking and Shanghai.

The following table shows the leading producing centres in this province :—

	ACREAGE (in *mow*)			PRODUCTION (in picul)		
Districts	1919	1920	1921	1919	1920	1921
Nanling ...	—	80,000	—	—	7,000	—
Lukiang ...	40,000	11,000	—	5,000	4,170	—
Tungcheng ...	—	40,000	50,000	—	10,000	7,500
Kweichi ...	—	12,050	12,500	—	2,663	1,500
Tungliu ...	—	50,000	52,000	100,000	15,000	5,200
Vonkiang ...	60,000	23,000	24,500	—	5,200	1,630
Chiaohsien ...	—	32,800	—	—	7,200	106,000
Howee ...	—	720,000	732,000	—	170,000	40,000
Hohsien ...	120,000	200,000	210,000	20,000	50,000	—
Other districts	2,600	26,845	18,000	535	20,743	2,000
Total ...	762,600	1,195,695	1,099,000	125,535	291,975	163,830

9. Kiangsi Province.—Cotton of this province is mostly grown in the eastern section. Lingchuen, Kingchi, Tunghsiang, Kwangfeng, Ningtu, and Vancha are the principal districts of production. In 1921, the yeild was only 45,325 piculs.

The following table shows the leading producing centres in this province :—

	ACREAGE (in *mow*)			PRODUCTION (in picul)		
Districts	1919	1920	1921	1919	1920	1921
Hsingchow ...	—	1,500,000	1,500,000	600,000	350,000	360,000
Wuyuoh ...	—	157,700	157,000	22,000	24,000	40,000
Ngocheng ...	—	180,000	180,000	41,500	56,000	52,500
Kiangkuo ...	—	133,000	133,000	18,000	24,000	16,500
Ouchi ...	—	166,600	166,600	36,000	30,300	17,000
Tuihudi ...	—	266,000	266,000	48,000	49,500	40,000
Kienli	—	361,000	—	49,000	65,000	—
Tanghsien ...	—	1,300,000	—	—	400,000	—
Vancheng ...	600,000	700,000	—	130,000	200,000	—
Other districts	—	1,505,400	447,500	262,500	381,200	89,150
Total ...	—	6,269,700	2,849,100	1,207,000	1,580,000	615,150

10. Hupeh Province.—Cotton is mostly produced in Yun Shui Valley, especially in Yun-meng, Yingcheng, Tien-meng, etc. In 1921, the yield was only 615,150 piculs. Usually in the ripe years, there are about one million piculs of cotton exported through Hankow.

The following table shows the leading producing centres in this province :—

	Acreage (in *mow*)			Production (in picul)		
Districts	1919	1920	1921	1919	1920	1921
Kiukiang ...	—	148,450	100,000	55,000	27,820	14,000
Hukuo... ...	—	46,400	—	—	8,800	—
Pangjih ...	—	34,000	—	—	7,490	—
Kunglung ...	—	170,000	150,000	50,000	53,750	30,000
Tunghsiang ...	—	—	840	—	—	290
Foongcheng ...	—	—	4,033	—	—	739
Tuchong ...	—	—	950	—	—	129
Tehan	—	—	360	—	—	31
Chingyen ...	—	—	180	—	—	48
Other districts	—	—	—	—	—	—
Total ...	—	398,850	256,650	105,000	97,860	45,325

11. Hunan Province.—Hunan, in spite of its favorable climatic condition, has given very little attention to cotton production. Changteh, Lungyang, Taoyuen, Nanhsien and Pingkiang are the only districts where small amounts of cotton are produced. Only recently, however, much land has been devoted to cotton cultivation in Hengyang, Pinghsien, Hsianghsiang and Changsha.

12. Kansu Province.—Kansu produces some cotton in its southeastern section, such as Fuyi, Kaotai, Mowmuh and Tenghuang, etc. The cotton produced is only sufficient for its local consumption.

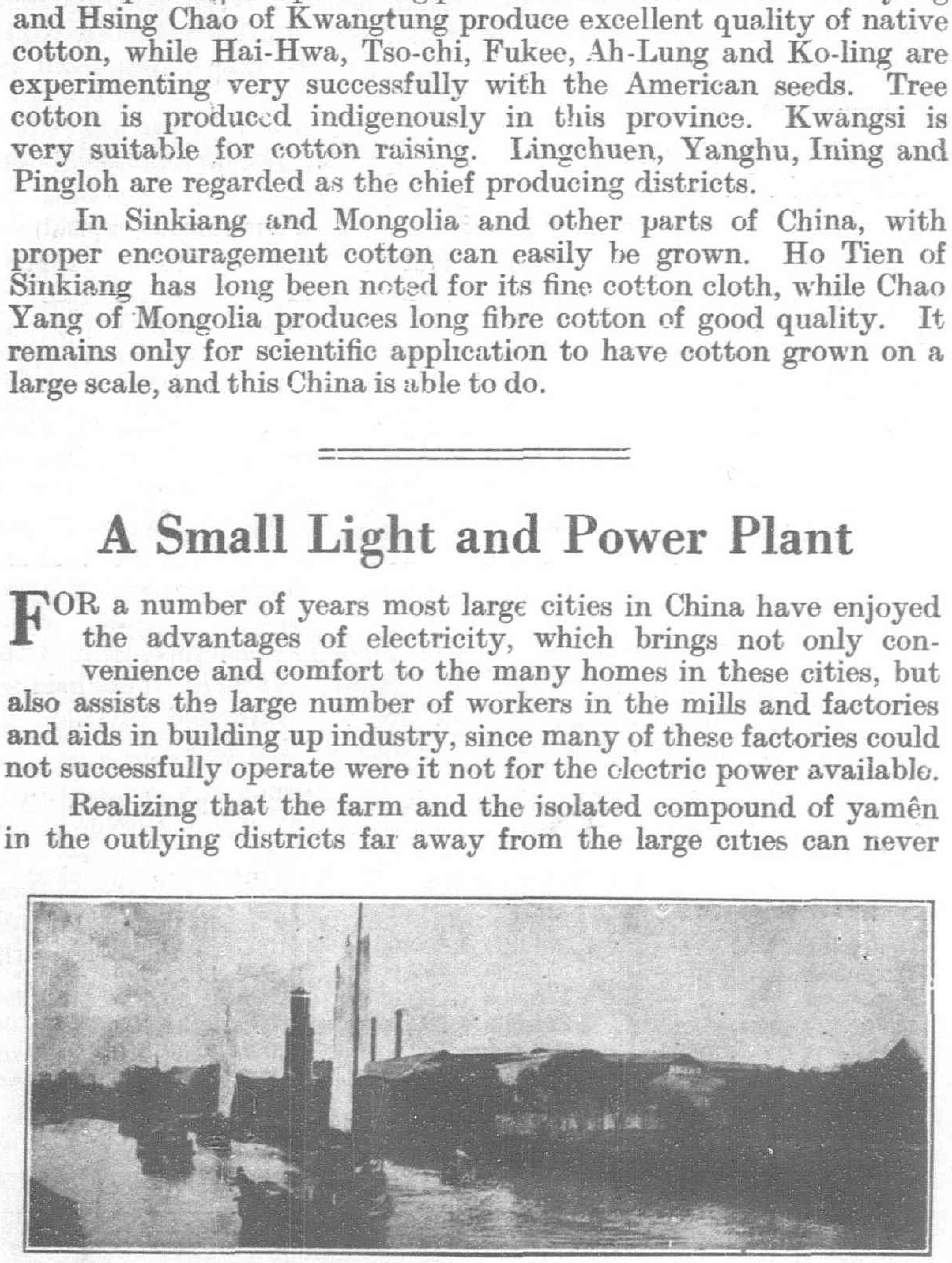
13. Szechuan Province.—Szechuan is now raising cotton to take the place of poppy, the growing of which is now prohibited by the government. Chengtu, Mien-yang, Fengchih, Tsunghsien, and Fushun are gradually becoming important cotton producing districts. Yunnan is taking the same step as Szechuan by growing cotton in lieu of poppy. Kwangtung and Kwangsi are two of the most important and promising provinces in South China. Fan-yang and Hsing Chao of Kwangtung produce excellent quality of native cotton, while Hai-Hwa, Tso-chi, Fukee, Ah-Lung and Ko-ling are experimenting very successfully with the American seeds. Tree cotton is produced indigenously in this province. Kwangsi is very suitable for cotton raising. Lingchuen, Yanghu, Ining and Pingloh are regarded as the chief producing districts.

In Sinkiang and Mongolia and other parts of China, with proper encouragement cotton can easily be grown. Ho Tien of Sinkiang has long been noted for its fine cotton cloth, while Chao Yang of Mongolia produces long fibre cotton of good quality. It remains only for scientific application to have cotton grown on a large scale, and this China is able to do.

A Small Light and Power Plant

FOR a number of years most large cities in China have enjoyed the advantages of electricity, which brings not only convenience and comfort to the many homes in these cities, but also assists the large number of workers in the mills and factories and aids in building up industry, since many of these factories could not successfully operate were it not for the electric power available.

Realizing that the farm and the isolated compound of yamên in the outlying districts far away from the large cities can never enjoy this comfort and convenience nor reap the full benefits to be derived from the many electrical devices designed to assist the laborer, until such time as electricity is available, the Westinghouse Company has designed a small light and power plant exactly suited to such an application.

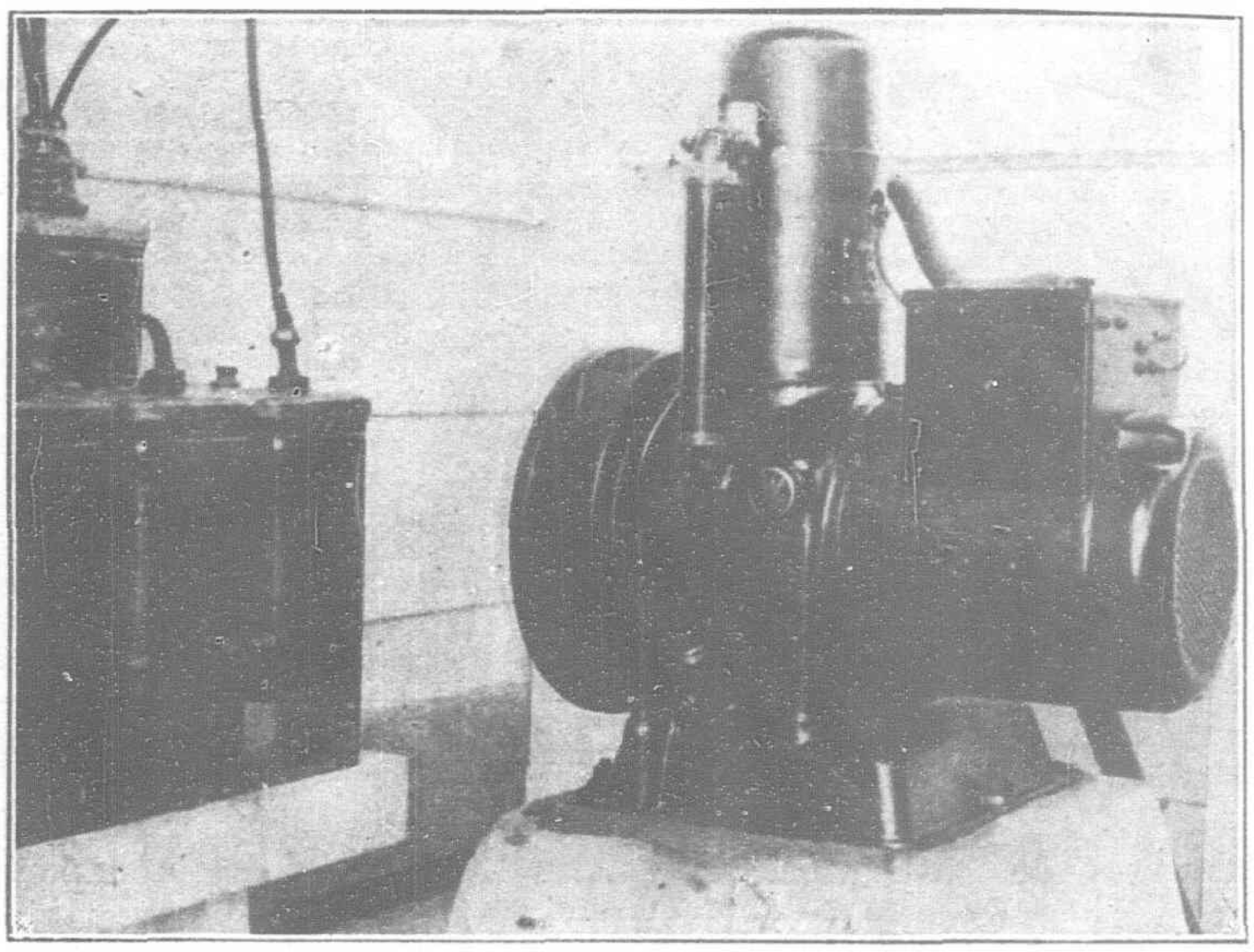


Factory of the International Food Products Company at Shanghai

The picture below shows this plant. It is so constructed and furnished with batteries that light and power are available at all times of the day and night whether the engine is running or not. Merely turning a switch will produce light in any part of the house or outbuildings. As is well known, electric light is far superior to that of any kerosene lamp, and in addition the annoyance of trimming wicks and filling lamps with kerosene as well as the disagreeable odor are all done away with. The danger of fire from overturning of a lighted kerosene lamp or candle is no longer present.

Electricity in isolated, outlying districts as furnished by one of these plants makes it possible, by supplying the necessary pumps, to provide automatic pressure water systems which will not only give the convenience of running water, but will also furnish efficient fire protection. By installing suitable motors, various small machines, such as, churns, rice hullers, feed choppers, and grain threshers, can be operated, permitting efficient and necessary work to be done after dark at the close of the day's labors.

The power plant comprises an internal combustion engine, utilizing either kerosene or gasoline, direct connected to a three-quarters kilowatt direct current generator operating in conjunction with a storage battery with a capacity of forty-five hundred watt-hours. This is sufficient to provide for the continuous operation of ten 20 watt lamps for twenty-five hours without the engine running, or forty-eight lamps with the engine running, or their equivalent in other devices.



Small Westinghouse Light and Power Plant Installed at the Works of the International Food Products Company

The Westinghouse light and power plant has been designed particularly with the idea of making it easy to operate, simple, and reliable. It is started by pressing a simple switch, and it stops itself when the batteries are properly charged. No attention is needed except at starting, which is necessary about every fifth day on the average farm. It is no longer necessary for outlying settlements to do without the many conveniences which electricity brings.

The photographs show an installation of one of these plants in the International Food Products Co.'s factory, located on the north bank of Soochow Creek near Shanghai.

One of the processes of this factory requires a large drum or well some 20 feet in diameter, and 30 to 40 feet high, completely enclosed and sealed to the outside atmosphere, in which the air is heated and conveyed as required by draft fans. It is necessary that this drum be lighted so as to observe the process, all open lights, such as, gas, oil, and candles being out of the question due not only to the fact that the moving air would extinguish them, but also because the odor, smoke, and dirt from such lights would seriously impair the quality of the products, which consist of egg yolk, albumen and whole egg, dried, powdered and flaked, and the various powdered and dried milk products.

Municipal Government in China

Street Cleaning System of Canton

By H. A. Pan, Commissioner of Public Health, Canton

THE cleaning of Canton city streets, maloos, and lanes, is being undertaken directly under the department of public health of Canton municipality. The work is conducted by the director of the sanitary division with a staff of assistants who form the nuclei of the administrative forces, says Mr. Pan in the *Canton Daily News.*

The forces directly controlling the street cleaning are the director, the chief sanitary inspector, the superintendent of street cleaning, the district superintendent, and the district inspectors and overseers. The whole city is divided into six health and sanitary districts. In each district, the district superintendent has the work divided among the inspectors, district overseers, gang foremen and scavengers. The city has a cleaning force of a thousand strong, comprising the gang foremen, cooks, scavengers, rat catchers, wagon-hands and emergency scavengers.

In the native city where maloos have not been constructed, street cleaning is done by scavengers who do the sweeping and carrying of the refuse to the nearest station where boats are provided for daily by the refuse syndicate, which pays to the government an annual revenue of seven thousand two hundred dollars. In the maloos the work is performed by the wagon scavenger force, who do the sweeping, etc., similar to the system conducted by the Hongkong sanitary department.

The emergency scavenger force is principally assigned to do the work which requires the least possible delay such as the cleaning and conveying of refuse accumulated in the different government quarters, clearing the roads for traffic after a fire has occurred and answering the call when a district requires a special force.

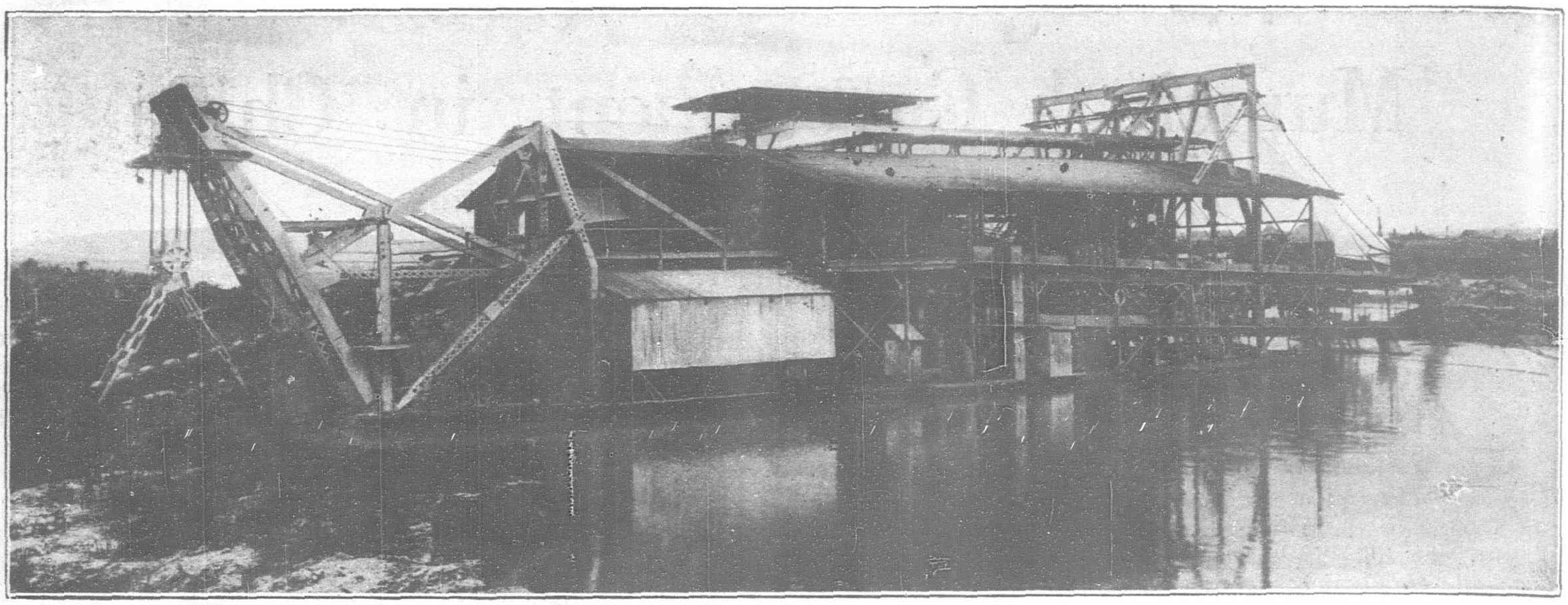
Sweeping one of the New Maloos of Canton

Strict regulations have been issued relating to refuse in the maloos and native streets. Occupants and store-keepers along the maloos are required to clear their refuse daily and dump the same into the wagons which are provided for the purpose twice daily. No refuse is permitted to be deposited along the maloos or roads under a penalty of fine.

The city has thirty-six scavenger quarters, besides quarters for the main wagon and emergency forces. The street cleaning forces are paid on a monthly basis. The scavenger provision funds are provided in advance every five days and the balance of their wages are paid at the end of each month. The scavengers are numbered consecutively. Each scavenger in the native streets is assigned to take care of a certain number of streets and lanes. In this manner, when the work is not properly done or totally neglected, the gang foreman, district overseers, and inspectors can at once trace the one who neglects his daily routine work. Each day the district superintendent is required to submit report of the work done for the previous day in printed tabulated form. The statistical value of each class of work done in a district is recorded and kept in the main office of the sanitary division, where weekly and monthly reports are submitted to the commissioner of the public health department.

The present system of street cleaning is a modified form of that of a few years ago. Owing to the continual opening of maloos in the city, the multiplicity of modern structures and tenement houses, the amount of refuse is increasing daily. The removal of filth and dirt, of the refuse of the four seasons fruits and vegetables, and of broken earth-ware, kitchen utensils, flower-pots, etc., is the kind of work which requires no small attention. The daily removal of approximately three hundred tons of refuse, besides the removal of building-refuse, is by no means a small task which the department has to perform in addition to various other duties. It is not too far-fetched to say that our Chinese people are too apt to accumulate filth and dirt. The public health question especially that relating to sanitation, is a novel thing to them. However, the publicity division of the department is doing everything possible to educate the common masses. They have to be educated to a certain standard before they can appreciate the importance of sanitation. We do not have to go very far to witness the deplorable sanitary conditions. The city of a few months ago had streets, lanes and maloos filled with accumulated refuse and the offensive smell and disease-producing bacil could be better imagined than described.

As regards the financing of this force, no special revenue has been set aside for the purpose. The frequent change of administration has produced bad effects. Street cleaning was neglected, and the people of the city suffered as a consequence. In order to make the street cleaning independent of the changes of the administration a special scheme of obtaining revenue from each store and occupant has been brought forward by the commissioner of the department, and the same passed by the city's administrative council, and approved by the mayor. It only requires the sanction of the governor. The tentative calculated sum will doubtless be sufficient to meet the expenditures. The yearly expenditures of this division amounting to approximately $150,000 is about 2 per cent. of the figure for New York city, where $7,000,000 gold are provided annually for the work, and about 37 per cent. of that for Hongkong, where the 1923 budget provides for $560,000 Hongkong currency for that purpose. It is to be hoped that an increase will be made in the yearly budget so that the sanitary condition of the city will be adequately taken care of.



The American Built Dredge on the Tronoh Properties of the Yukon Gold Company: Capacity 125,000 cu. yds. per month

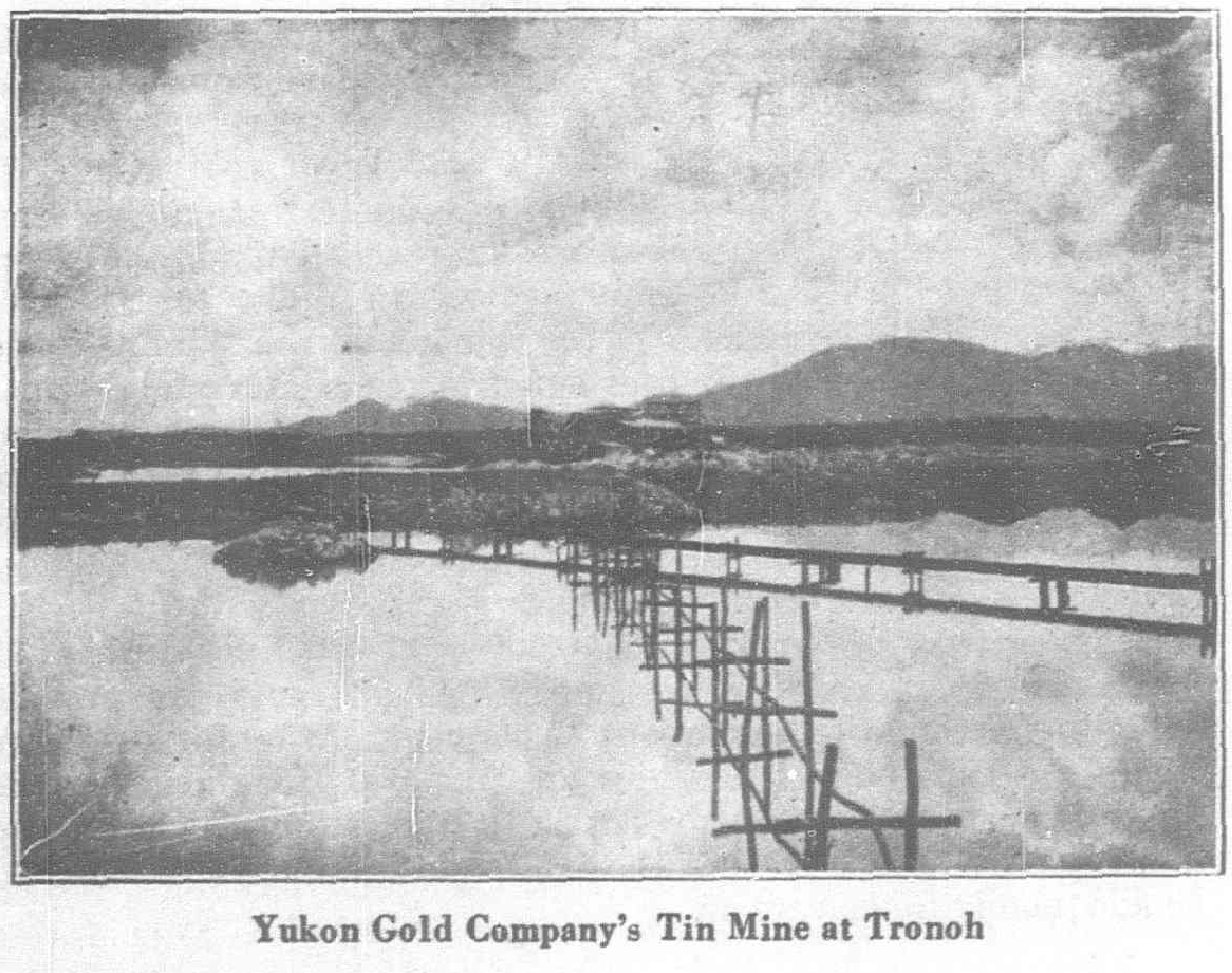
American Tin Dredging in Malaya

THE Yukon Gold Company will soon begin operations on a large scale in the Federated Malay States, with seven steel dredges costing approximately $500,000 each. The company some time ago acquired alluvial tin properties located near Tronch, Kampar, Ampang and Salak and from 2,182 acres tested by borehold, a yield of over 75,000,000-lbs. of metallic tin is estimated. The first three steel dredges were dismantled upon the exhaustion of gold ground in Alaska, shipped across the Pacific to their new location and set up again on the river beds from which they are to extract vast quantities of tin ores. Each of these dredges has a minimum capacity for treating 100,000 yards of ore monthly, but through improvements it is expected the capacity will be increased at least fifty per cent. Five thousand acres are now owned by the company, which, it is estimated, is sufficient area for at least twenty years, while additional property is being acquired.

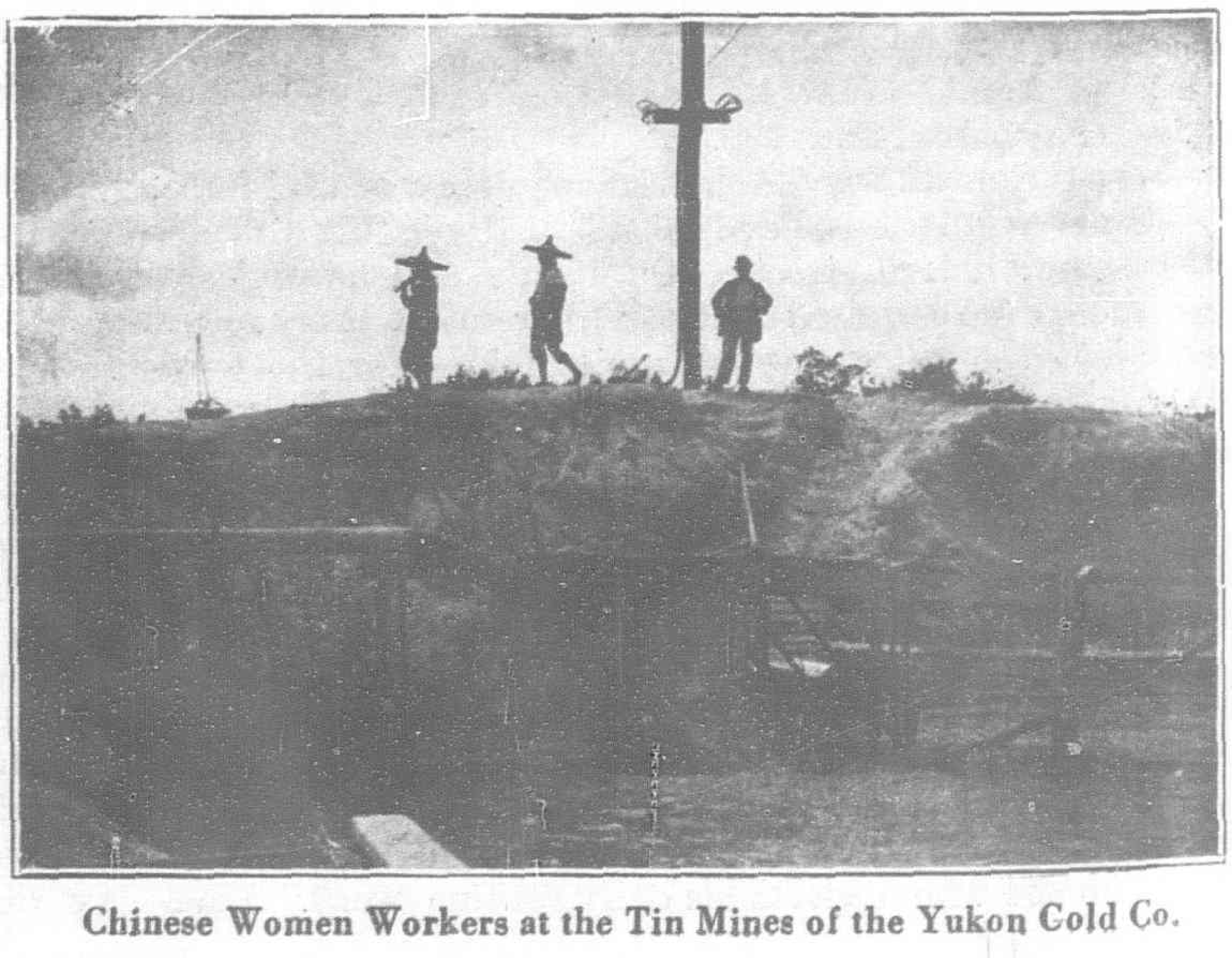
The executive head of the company is Mr. William Loeb, once secretary to President Roosevelt, with offices at 120 Broadway, New York. The Guggenheims are largely interested, with four brothers on the board of directors. The head office in the F.M.S. is located at Ipoh, with Mr. G. H. Munro in charge as general manager.

It is of interest for purposes of comparison to note that there was profit in dredging gold on ground that yielded ten cents a cubic yard. One pound of tin a cubic yard is the demonstrated yield from the Malay river bed. Power plants are installed on these dredges and, as the earth is scooped up, it is concentrated on the dredges and the concentrates bagged and sent to smelters, which are chiefly owned by British. An export duty, prohibitive in rate, is levied on shipments of tin from the Malay settlements; this makes it impossible for the American-owned company to send concentrates to the United States to be smelted and sold.

What gave promise of developing into a new American industry was started during the war, when several smelting companies commenced to smelt tin in and around New York. About $3,000,000 was spent in equipment for handing this metal. This smelting activity has since disappeared, owing to various unfavorable conditions, except in one instance where a small smelter is importing Bolivian tin.



Yukon Gold Company's Tin Mine at Tronoh



Chinese Women Workers at the Tin Mines of the Yukon Cold Co.

Refrigeration and Storage of Food

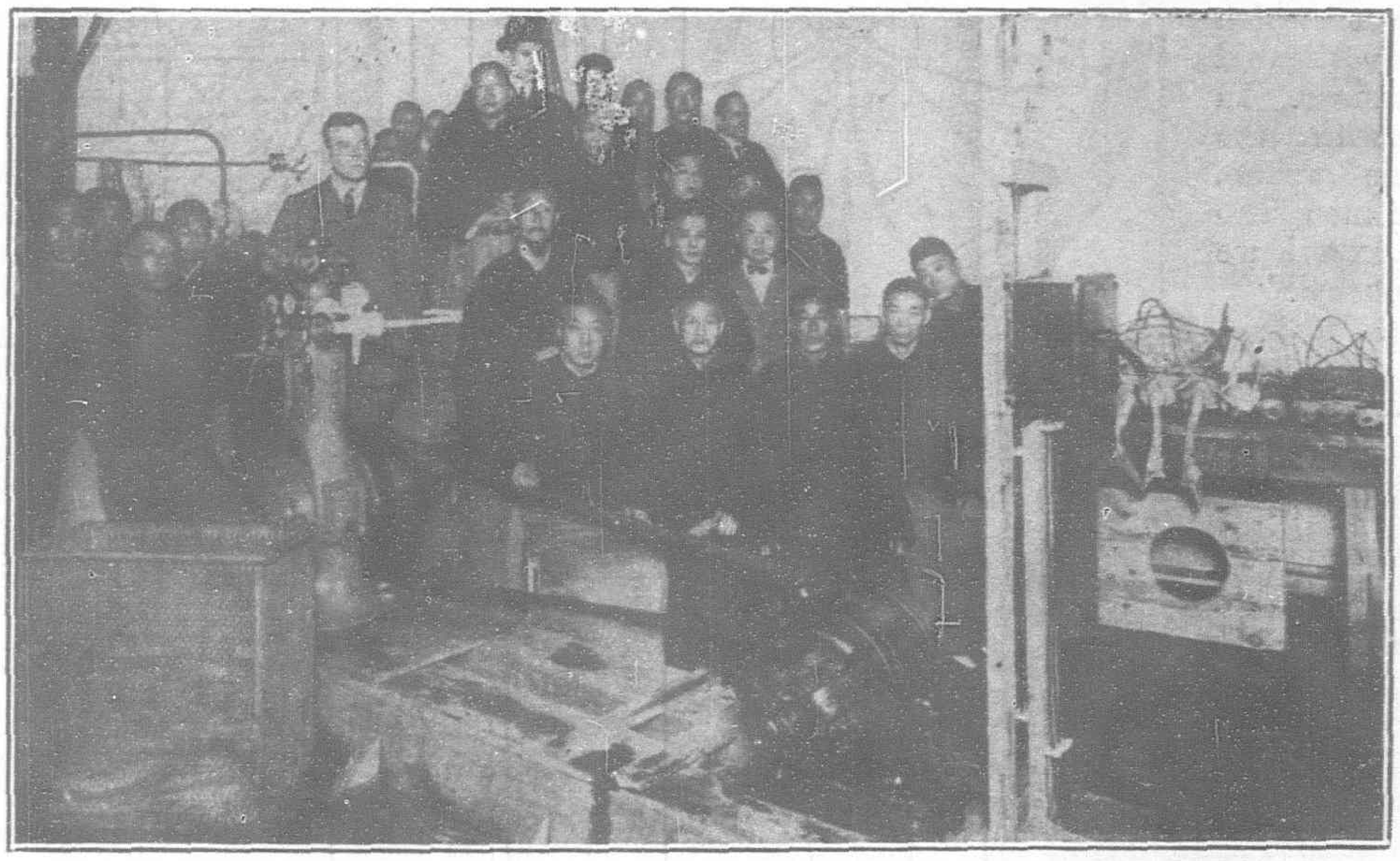
With Special Reference to Fish

By H. Berents

THE use of artificial cold for the conservation of food commodities has now been generally adopted.

As regards the history of refrigeration as applied to what is popularly called "cold storage" no authentic history can be formulated, and it is only within the last forty to fifty years, and particularly during the last great war, that the practical usefulness of refrigerated storage has been fully appreciated by governments and individuals all over the globe.

Refrigeration represents, as a matter of fact, the most natural method of conservation and has the advantage that the food commodities need not be brought in contact with chemical ingredients, which easily cause permanent changes, but allow the consumer to receive the goods after long storage in more or less its original form and condition.



The Demonstration Plant of the China Refrigerating & Investment Company, Ltd., Testing Ottersen's Freezing Method with a Machine made by Thos. Sabrue, of Aarhus, Denmark

When scientific inquiry had proven the efficacy of low temperatures in preventing decay and had demonstrated the possibility of obtaining and maintaining low temperatures at will, the cold storage business of to-day was but the natural evolution resulting from such demonstration. When it became apparent that profit was obtainable by placing perishable goods in cold storage during a period of glut or surplus and disposing of them at some subsequent period of comparative scarcity or increased demand, the building of cold storage houses and the perfection of machinery or apparatus for their economical operation became the inevitable result. The pioneers in the cold storage business were speculators of the extreme kind, but this cannot be said of those in the business to-day. Where in the early days the cold storage operator owned the goods he stored almost entirely, and his customers were uncertain, now the goods placed in cold storage are almost wholly owned by dealers, and are held for the supplying of their regular trade.

Refrigeration has four chief uses in the economy of nature and in commerce :—

1. To prevent premature decay of perishable products.
2. To lenghten the period of consumption and thus greatly increase production.
3. To enable the owner to market his products as needed.
4. To make possible transportation in good condition from point of production to point of consumption, irrespective of distance.

FIRST : Without refrigeration there would be much actual waste from decomposition before it would be possible to place perishable food products at the disposal of the consumers. The immense fruit trade of the Pacific coast would never have been developed without the assistance of refrigeration, nor could the surplus meat products of the southern hemisphere and China have been brought half way around the globe to relieve the shortage in thickly settled England and to supply the armies with fresh meat during the great war without its aid. Without the aid of refrigeration to create a constant market, the production of meats, of eggs, of fruits and other food products would be greatly curtailed, and as regards the fisheries along the China coast these can most decidedly be greatly developed with the aid of refrigeration to the benefit of the population.

SECOND : In any class of produce the ordinary season of consumption was formerly limited to the immediate period of production, or but briefly beyond. Now nearly all fruits may be purchased at any season of the year and dairy and other products are for sale in good condition and at reasonasle prices the year around.

THIRD : Instead of being obliged to bell perishable goods, when produced or purchased, at any price obtainable, the owner can now put away in cold storage a portion or all of his products to await a suitable time for selling. This not only results in a better average price to the producer, but places perishable food stuffs at the command of the consumer at a reasonable price at all times and greatly extends the period of profitable trading in such products.

FOURTH : The certainty and perfection with which food products may as a rule be conveyed from the place of production to the large centres of population where they are to be consumed is one of the triumphs of refrigeration.

Refrigeration, as well as other methods of conservation, retard or paralyse the chemical and bacterialogical processes in the goods to be stored. The speed with which chemical reaction takes place can be greatly reduced by lowering the temperature, and the growth of bacteria proceeds considerably slower by the lower than by the higher temperatures. Many bacterias are as a matter of fact not able to develop by temperatures in the neighborhood of 32°F. Some parasites, as, for instance, the fins, were totally destroyed by temperatures from 14° to 18°F., according to tests carried out by Rissling, Glage and Reissman. By reducing the temperature the freezing point is soon reached, which by the bulk of food commodities is practically the same as for water because of the high water contents of our food products.

All products which can be frozen shows a considerably greater durability than those which may only be chilled to a temperature somewhat about freezing point, as for instance fresh eggs, the greatest number of fruit, vegetables, margarine and others. A very long period of cold storage can therefore not be applied to such products.

The humidity and the air circulation plays a very important role, besides the temperature, particularly above the freezing point.

Whereas the generation of low temperatures have to-day reached a very high degree of development and efficiency, due to the most careful scientific research, the same can not be said about the utilization of the low temperatures obtained for preservation of food commodities. The cold storage of food commodities have been carefully studied in a scientific manner in practice for a few food products only and we rely generally on subjective observations which have been generalized without any real justification. Only hereby is it possible to explain the contradictions which exist between the different cold storage authorities as regards the most suitable cold storage conditions for different food products, as fruit, frozen meat, fish, etc. Mr. W. D. Richardson's remark is worthy of notice in this connection :—

> " If the authorities are consulted on the subject of cold storage, we find a variety of opinions expressed which are quite lacking in agreement, as would be expected in a subject which has been so little investigated in a scientific manner. In marked contrast with the opinions of scientific writers are the statements of men who have had practical experience in cold storage warehousing."

Some scientific studies in cold storage have been carried out lately but here is undoubtedly a large and thankful field open for research work.

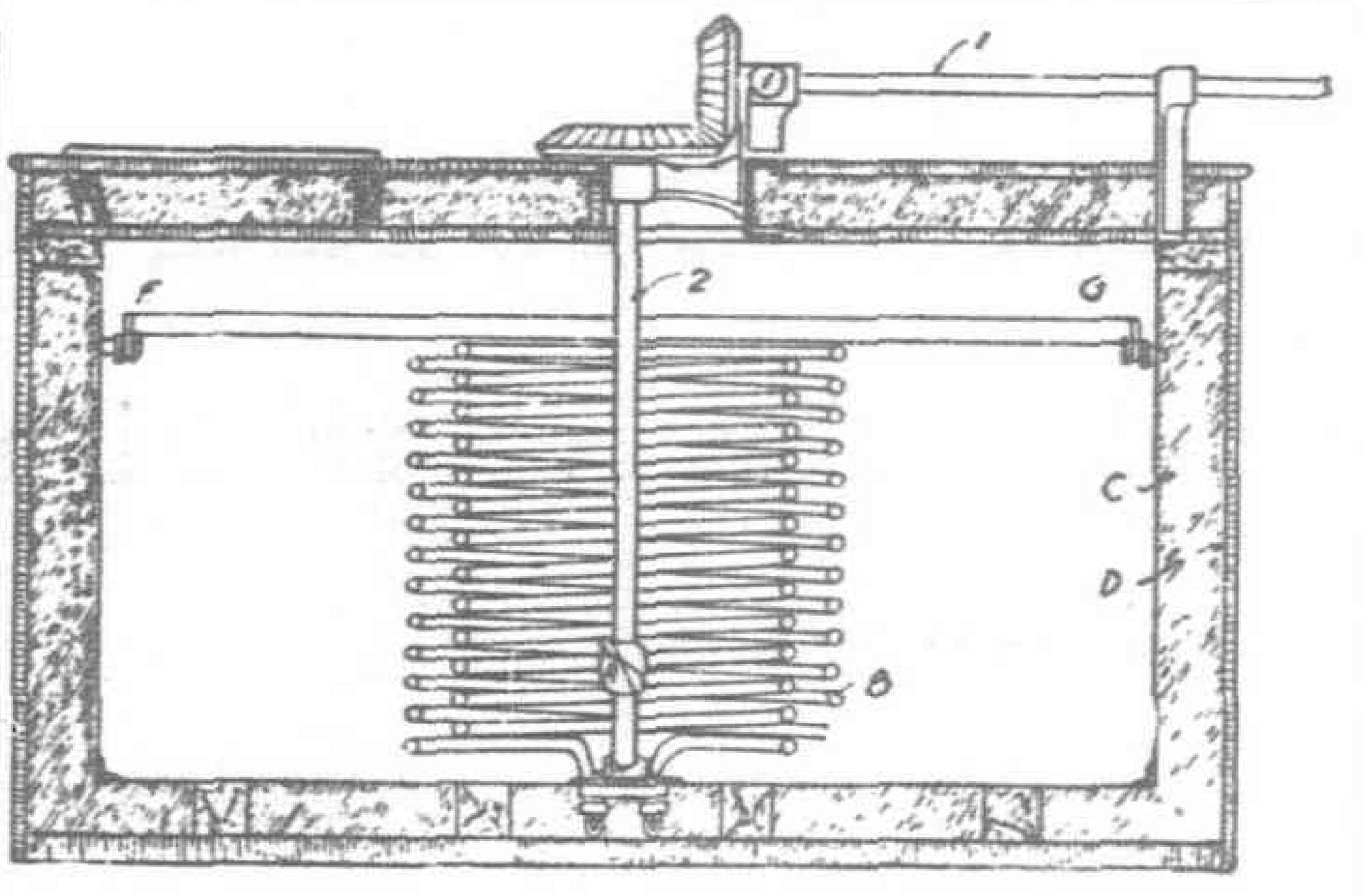
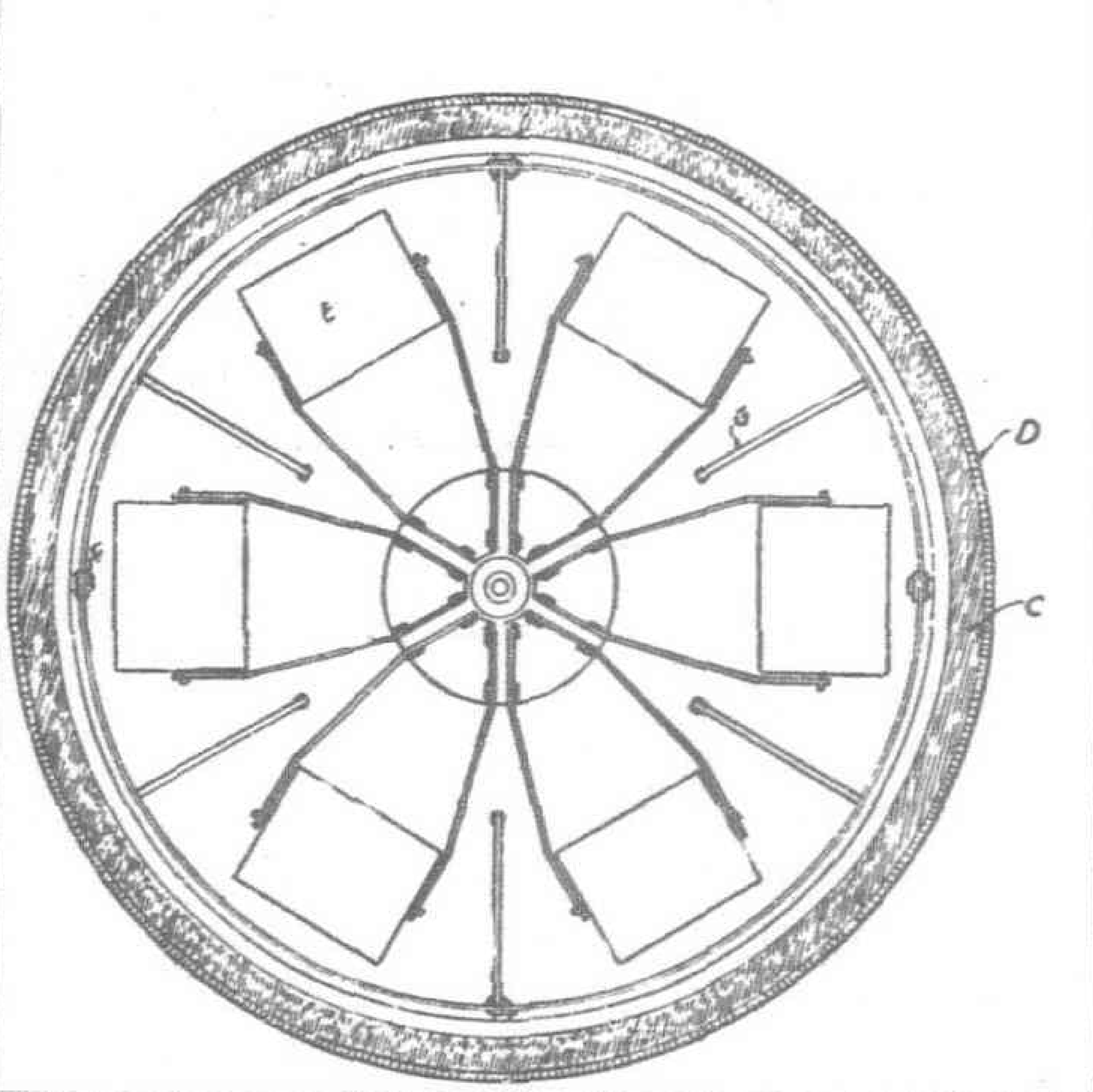


FIG. 1



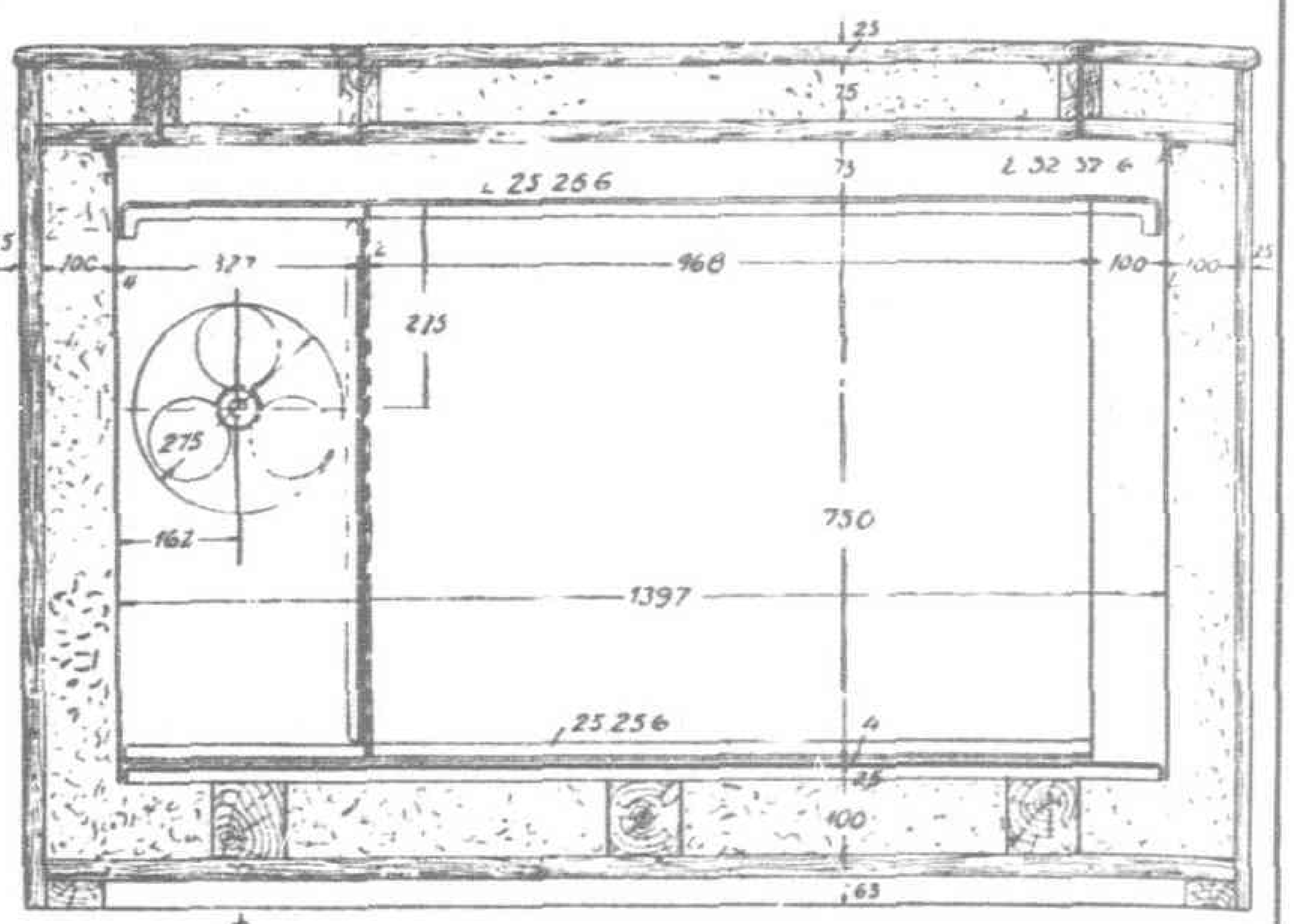


FIG 3

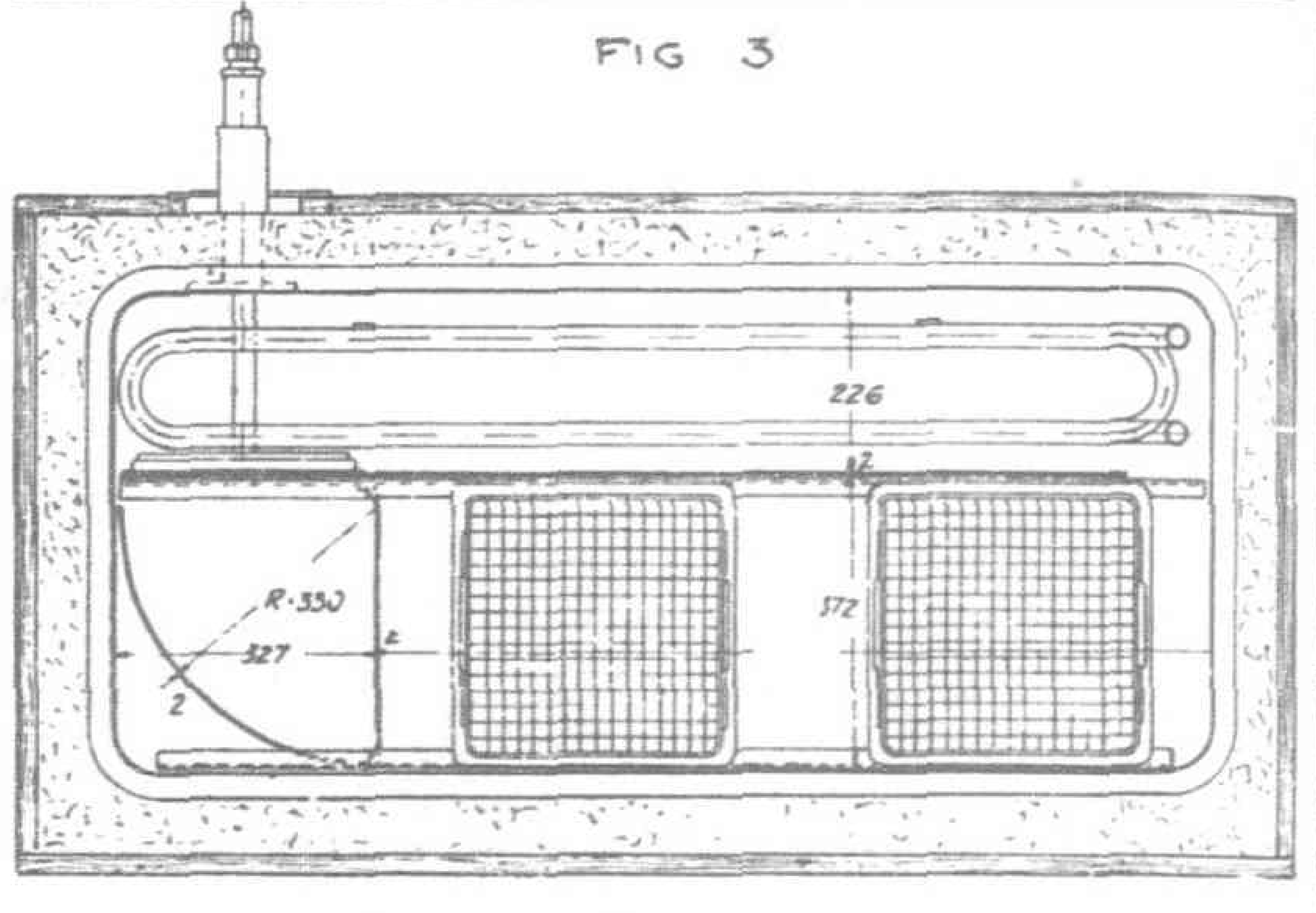


FIG 4

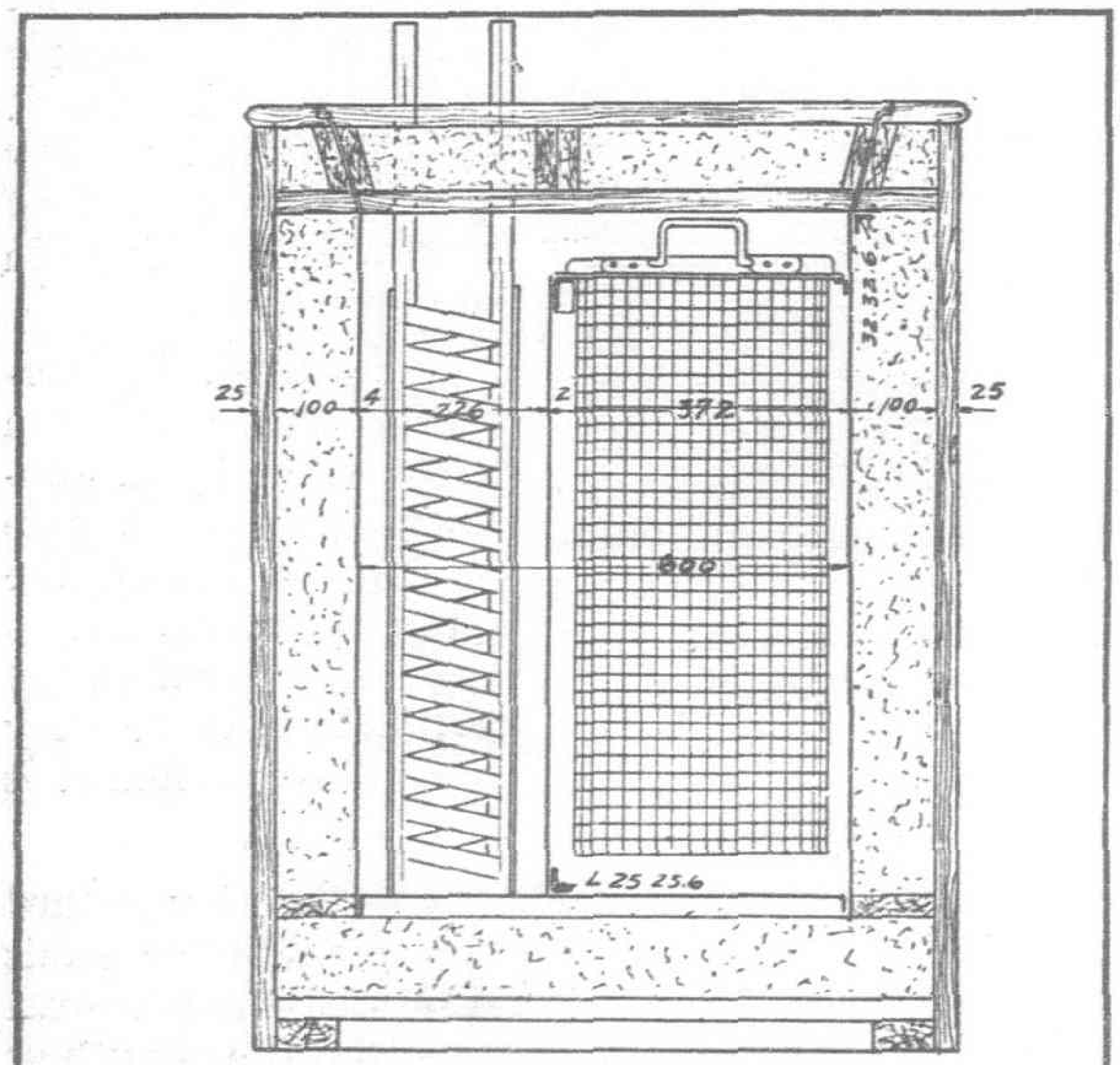


FIG 5.

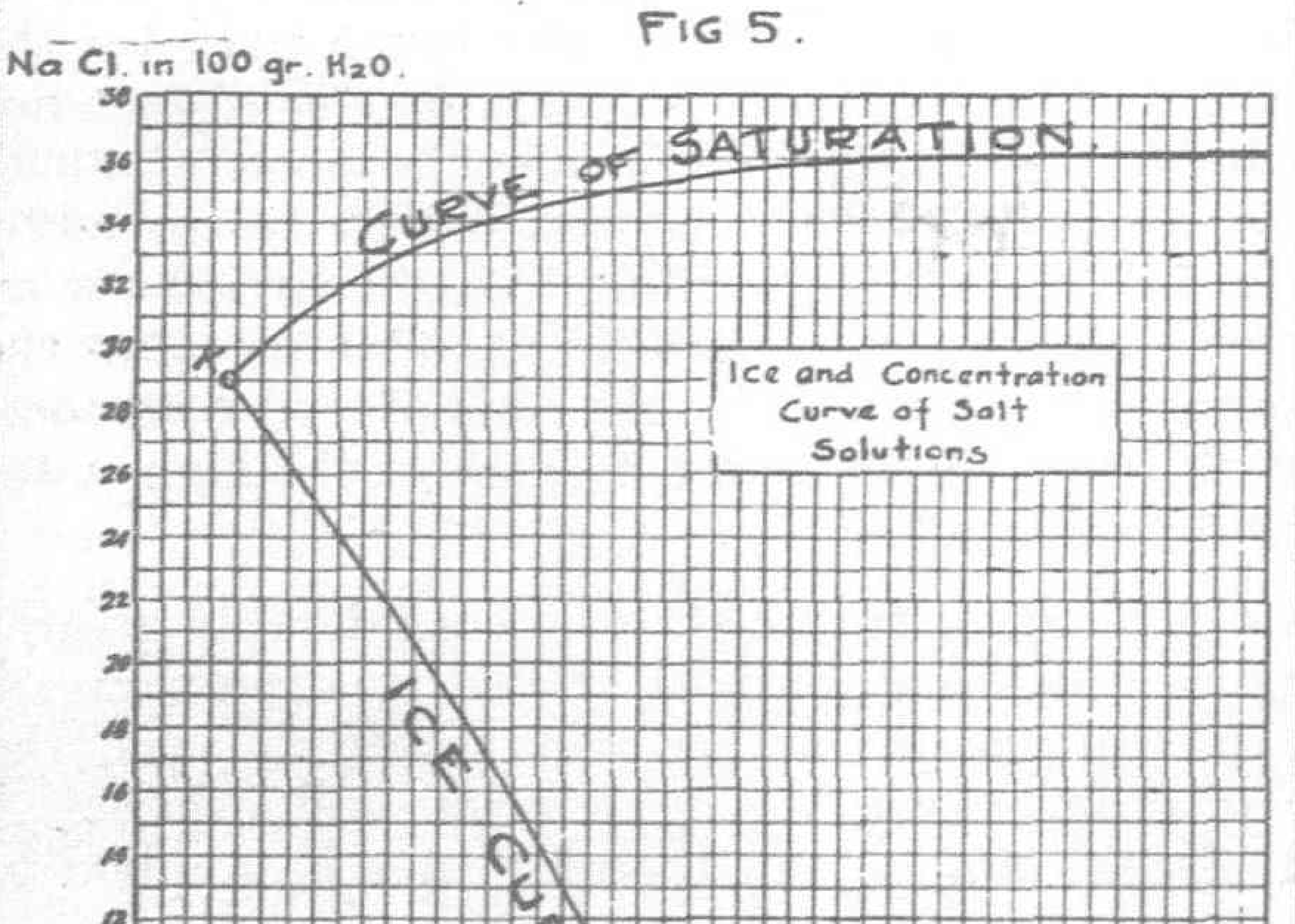
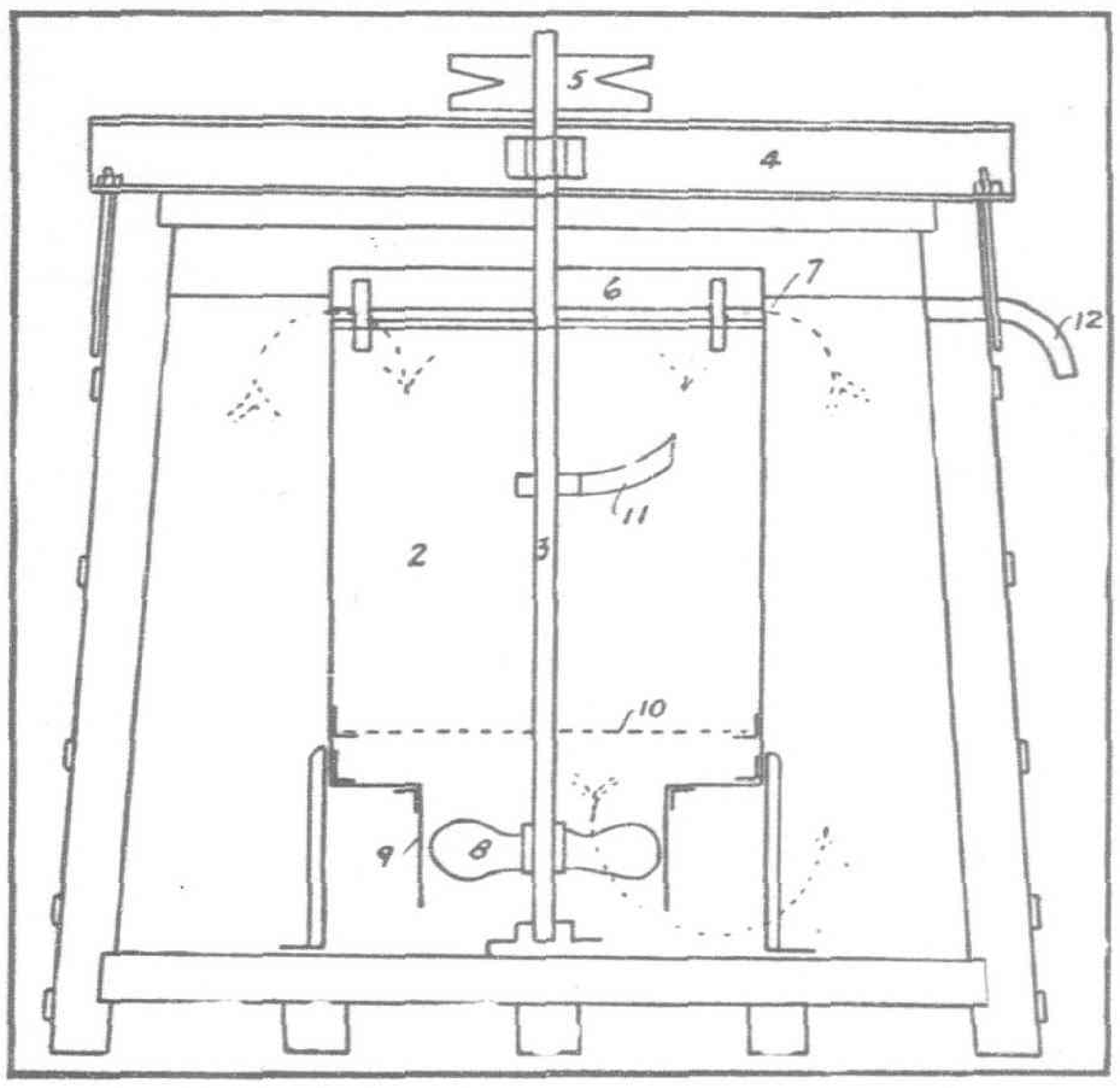
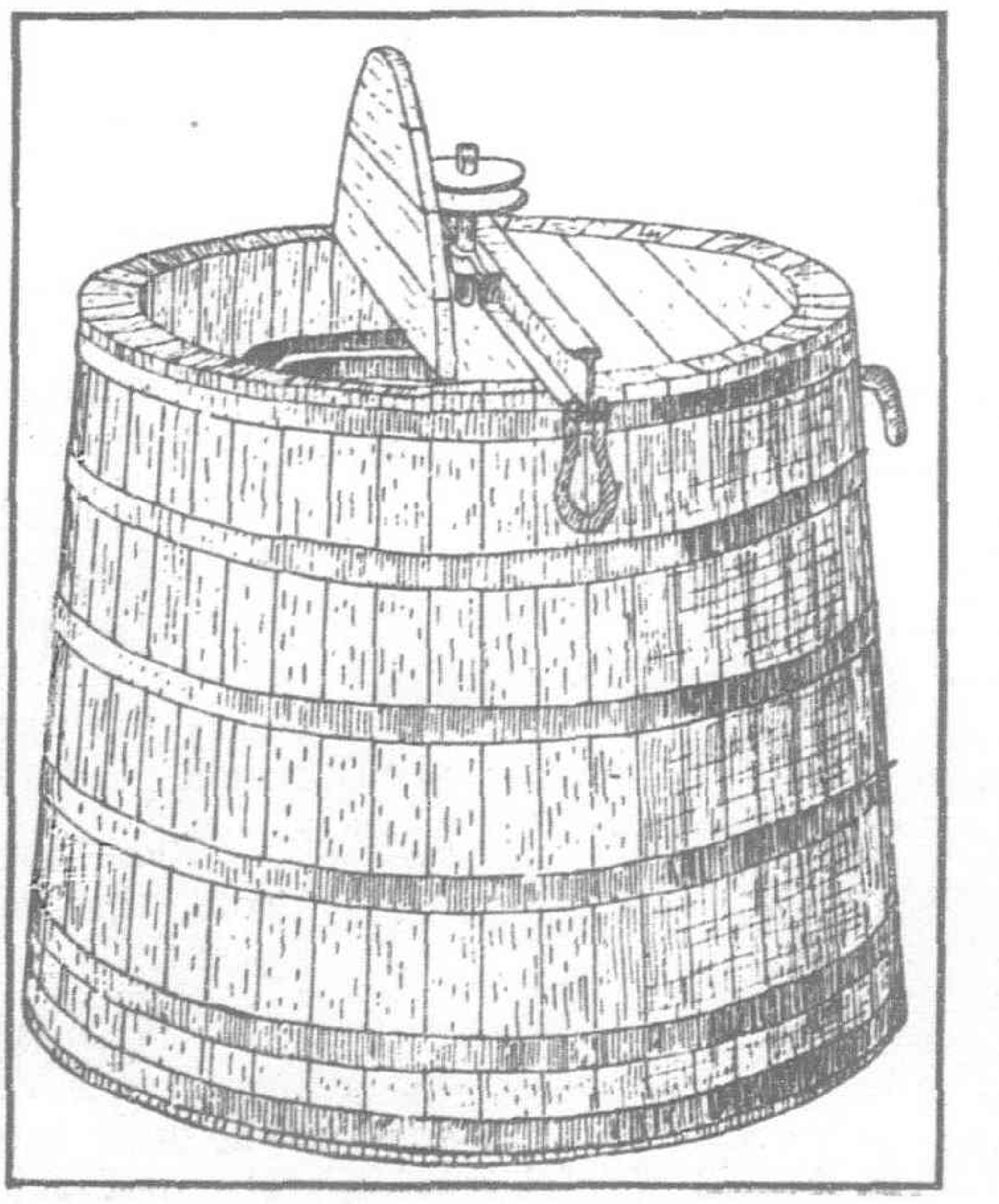


FIG. 6.





I will only mention a few of the existing contradictions : Meat has been frozen in Europe for years in comparatively high temperatures 18° to 25° F. whereby a slow freezing takes place. The freezers have been cooled down by air circulation or by a combination of pipes and air circulation which causes the meat to freeze by a lively movement of air. In America, where they have a larger experience in freezing of meat, the temperatures are kept in much lower in the freezers + 5° to -4° F. whereby the meat freezes considerably quicker. The rooms are cooled down by pipes only whereby natural air circulation is created.

If we consider the cold storage rooms for frozen meat then large contradictions exist also here. The Americans employ considerably lower temperatures, and research work lately carried out indicates clearly that cold storage conditions were much improved by reducing the temperatures.

At the same time was proved that the humidity can be much higher by low temperatures (90 per cent. and more) than formerly accepted (75 per cent. to 80 per cent.).

There are still greater contradictions relating to the cold storage of fruit and particularly fish.

Frozen fish is generally kept in cold storage by 18° to 20° F. in Europe whereas the Americans as a rule use much lower temperatures. Authorities as Mr. B. Butzler, have also maintained that fish is not suitable to freeze, but should be kept at a temperature close to the freezing point but not below. Mr. A. Gruvel recommends to store the fish in the neighborhood of 32° F. but not in temperatures lower than 26° to 28° F. so as to prevent that they freeze entirely. These authorities consider that salmon may stand freezing well but other fish will deteriorate because the muscles are torn apart by the expansion of the loose cellular tissues when frozen whereby the fish will crumble and develop symptoms of decay.

Fish is undoubtedly a much more difficult commodity to preserve by refrigeration than is meat, particularly if followed by a prolonged period of storage, and frozen fish has for years been open to objections because at its best, some impairment of texture or flavor, or both, has always occurred in the article frozen. On this ground there no doubt exists a certain well-founded public prejudice against frozen fish, particularly in the United States where the fish has to be sent for long distances, and also in Europe. But in the U. S. comparatively little fish is consumed in the interior states, most probably for the above reasons.

I remember well when going to the fish markets in Norway that the fishermen could never obtain a good price for fish which had been frozen hard in the winter, because, it was maintained, that such fish had lost much of its flavor, and no doubt in the case of fish the impairment of flavor and texture consequent upon freezing in the air, is, as a rule, readily noticeable. And yet freezing has been practiced extensively in the fish industry for many years because the flavor developed during ripening of the fish when held unfrozen is disagreable to the human palate, and several methods suggested and employed, as applied to preservation of fish by refrigeration.

But for the fact that fish can be frozen and held in storage for many months without change in food value or flavor vast quantities of fish would go to waste, and this valuable nitrogenous food and substitute for meat would be scarce or even unobtainable, except in the smoked, salted, or canned form, during a large part of the year.

The additional fact that fish properly frozen may be shipped long distances without deterioration permits many inland communities in Europe or America to obtain at any time of the year favorite varieties of fish caught in distant waters. But in China where fish is a most popular dish, it is practically impossible to-day to get a decent dish of fresh sea fish in the interior, where often at feasts a wooden fish is placed on the table so as to keep up appearances.

Frozen fish are superior to salted or cured or smoked fish, excellent as these are for food, and eminent scientists and fish experts have repeatedly stated that they could not tell which were fresh and which were frozen fish, when both were cooked and placed on the table at the same time as a test. In taste and texture of the flesh it was further impossible to distinguish the fresh fish from that frozen and stored according to the best method known.

In refrigerating food commodities the following methods may be employed :—

A. Air—or dry—Freezing.
B. Brine—or Liquid—Freezing.
C. Freezing in Ice Blocks.

A. Air Freezing

By the air freezing method the fish is placed in a room of a low temperature and left there for 5 to 30 hours according to temperatures employed and to size of fish to be frozen. To accelerate the freezing process an artificial circulation of air may sometimes be applied, but air, which is a very poor conductor of heat, is depended upon in a large measure to convey the heat away from the fish to the cooling medium. The consequence of this is that a long time is required for complete freezing. The consumption of time is in itself a serious objection from the point of view of plant operation but it is not the most serious objection.

It is obvious that food containing much water, as fish, will be considerably dried by the air freezing, particularly if artificial air circulation is to prevent the fish to become mouldy whereby a loss in weight will be suffered, and the slime which is the natural protection of the fish, will dry out, and give injurious bacteries and parasites, which may be available in the surroundings, easier access to the fish. Furthermore, when a juicy article is frozen, small crystals of ice begin to form as soon as the freezing temperature is reached. If the freezing proceeds slowly, the water diffuses from the surrounding tissue to build these small crystals to large ones, but if freezing takes place rapidly the water does not have time so to diffuse and very numerous tiny crystals are formed instead of fewer coarser ones, but air freezing proceeds slowly. When ice crystals are formed, the increasing size of each crystal ruptures, or the sharp angles puncture the cell membranes, the effect of such ruptures or puncturings is equivalent to a bruise throughout the body of the fish. It has been established by scientific investigation that these bruises on fish, or meat have a similar effect to that of bruises in fruits, that is they cause decomposition. This decomposition is not directly harmful or dangerous in food, but it gives rise to a repugnant smell and flavor and causes liquefaction of the tissues and consequent loss in handling. It is thus seen why fish which have been frozen in air rapidly disintegrate on thawing out and loese the nutritive juices of the fish-meat because they have been damaged throughout by formation of comparatively large ice crystals.

The above facts have been more or less recognized by some scientists and fish exporters as far back as in the eighties in Norway, and according to Stevenson still further back in the United States, and the aim of the different methods suggested have been to improve the air freezing process by greatly to hasten the freezing of the fish thereby trying to prevent the formation of large ice crystals. This can be done by employing the liquid freezing.

B. Liquid Freezing

To improve the air freezing method an English fish export company employed salt and ice in Lofoten, Norway, about 1880, with varying results. The Norwegian fish inspector Mr. Wallem constructed two fish freezing barrels in 1890 in which herrings were frozen by direct contact with a mixture of salt and ice. The barrels were rolled to secure a good mixing but although the herrings were quickly frozen they were partly squashed and lost their slime and scales. By adding a surplus of very fine broken ice and mixing well it could be prevented that the herrings absorbed salt in any noticeable degree.

The French Engineer H. Rouart obtained a British patent in 1898 on a method to freeze food commodities, meat, fish, butter, etc., by immersing the products to be frozen in a liquid cooled down by refrigerating machinery. As suitable liquids were recommended mixtures of water and glycerin, water and alcohol, water and sea salt or other mixtures of suitable concentrations with temperatures to—4°F.

Mr. Rouart's method has the advantage that the product to be frozen does not come in contact with hard ice but with a cold fluid, whereby the outer mechanical action as by Wallem's method is eliminated. The employment of a refrigerating machine instead of a refrigerating mixture (as salt and ice) makes it furthermore possible to obtain a more quick and continuous freezing. The method has, however, the disadvantage that the salt can easily permeate the bodies frozen in any of the mixtures recommended.

As long as sea salt is employed and the infiltration of salt is limited to a thin surface, such permeation may not be considered as objectionable, but rather as a preservative, since we must salt the fish in any event before we eat it. This might be conceded if the objection to salt rested on the taste of it. However, the major objections to salt penetration are, first, that penetration of salt is always accompanied by great extraction of water, in accordance with the laws of osmosis, and therefore, loss of weight, and second, that much salt in the skin or on the surface of fish or meat makes it impossible to glaze them, and, thirdly, in practical running the brine is inevitably contaminated, principally by a gradual rusting of the iron or steel parts of the receptacle with fittings as well as by absorbtion of gas formed matter for instance the carriers of the so-called fish smell. Glazing is of the greatest importance if fish have to be transported without ice or stored for more than a short period; if they are not glazed, rapid drying, loss of weight and of edible qualities ensue.

Mr. Rouart does not indicate ways and means whereby the osmotic processes between the mixtures recommended and the fish or meat to be frozen may either be eliminated or at least reduced.

Great merit is due Mr. A. Ottesen, a Danish fish-exporter, who, after years of long research, discovered the correct method whereby the process of liquid freezing has become a practical success.

Mr. Ottesen obtained his first patent in Denmark about 1911 and in Norway in 1913 for " A method of freezing or refrigerating comestibles of the kind in which the comestibles are treated with a solution of a substance adopted to lower the freezing temperature of the dissolving medium and which is of high osmotic activity and strong taste, the treatment being such that the substance in solution is prevented from penetrating into the comestibles, the solution at the beginning of the treatment containing easily accessible latent cold in the form of ice."

This discovery, in making the cooled solution of one or more inorganic salts to an indifferent conductor of cold, prevents that any salt permeates the commodities immersed in the solution for freezing.

To obtain this result Mr. Ottesen recommended at the outset to choose the concentration of the salt mixture of such a strength that the mixture will keep at its freezing point, by the temperature on which the plant is designed to run, whereby the mixture will shed clean ice, not as ice-crystals, but as soft snowlike bodies which partly swim on the surface and partly settle on the cooling coils.

The temperature of the mixture vary according to the strength from about 14°F. to about–4°F. (–10°C. to–20°C.).

The original form of the apparatus demonstrating this method is shown in Figs. 1 and 2 and consist of a well insulated sheet iron tank of 2 metre diameter and one metre high in which the cooling coil B is placed concentric. The coil is connected with an Ammonia refrigerating machine with a capacity of 5,000 calories per hour (20,000 B.T.U.) A steet axle with propeller " A " is placed in the centre of the tank in which the brine is brought in lively circulation by the driving axle one Fig. 2 shows a horizontal framework F-G which carry six baskets E made from steel wire and can revolve about the central axle 2. The fish is frozen in these baskets which are provided with lids. In Figs. 1 and 2, C indicates the insulation and D the outer wood covering of the tank. Very satisfactory results were obtained with this apparatus in the biological station in Bergen, Norway and a similar apparatus was also worked in Thisted, Denmark. Fish frozen according to Ottesen method were stored for shorter and longer periods, packed in ordinary wooden boxes and sent to England, Germany, France and Austria with the most astonishing results.

A later design of Ottesen is shown in Figs. 3, 4, 5 where the tank is made in a rectangular form and the refrigerating space divided from the coil by a vertical wall. Two large fish baskets made from steel wire can be placed in the refrigerating space and a propeller with horizontal axle forces the brine over the coils and through a sheet iron wall, with many small holes, evenly distributing the cold brine through the fish baskets. The tank is well insulated and covered with wood.

Fish frozen by this method is handled in the following manner : The fish may first be cleaned and left for a while in cold water to be chilled. When large fish is to be frozen individually a weight is attached to the tail or to the head of the fish to have it maintain a vertical position in the brine chamber. Otherwise the fish is placed in the baskets which are closed by a heavy lid when emerged in the brine. After completing the freezing the fish is dipped in fresh water whereby the brine drops sticking to the fish are washed away and the fish get a light ice glacing, whereupon the cold storage follows.

To freeze in a cold salt mixture according to Ottesen has important advantages as compared with air freezing, of which may particularly be mentioned. The entire avoidance of loss of weight during the freezing process and thereby the maintainance of the live fresh appearance of the fish. Further the exceptional quick freezing, which prevents formulation of large ice crystals whereby the texture is preserved, and also permits to freeze a large quantity in a small space.

To explain what really takes place we draw the ordinary ice curve of any concentration of salts, see Fig. 6. Ottesen's former freezings used always to take place according to this curve, and the point " K " marked as the freezing point of a completely saturated solution. The freezing temperature of such a solution is minus twenty-two degrees C or-8F. Below this point practical working was not possible owing to the fact that the concentration would begin to freeze and solidify at this temperature.

I am, however, advised that by following Ottesen's directions and improved method the temperature of concentration can be lowered far beyond this point and the freezing of the comestibles takes place comfortably without any ice formation in the concentration and last but not least, the evaporator coils of the refrigerator keeps itself automatically clean of ice formations. Meat, fish and other comestibles immersed in this concentration freeze naturally in a fraction of the time required by air freezing or freezing in ordinary concentrations.

When comparing the time required for freezing in air of 19F°. and in brine of 5°F. the freezing in brine will be 20 times as rapid. If for air freezing indirect cooling is used by brine coils, then the expansion temperatures of the refrigerating machines are in both cases—4°F., whereby the amount of energy required will be the same.

Furthermore small fish or pieces of meat are frozen by the temperatures generally employed 20 times as fast as by air freezing, medium sizes fish 12 to 15 times as fast, and large fish 10 times as fast. Half-pound fish freeze in from 20 to 30 minutes, 4 pound fish in about 1½ hours, large salmon and cod in about 5 hours. This rapid freezing makes the method particularly applicable to handle large gluts of fish and the small dimensions required makes it very suitable for steamers with more or less limited space.

The same brine is used over and over again for a long time, and, but little filtering (skimming) is necessary. On this point, the food investigation board (Great Britain), wrote, in connection with its investigation of the method :

" It may be noted in passing, as a point of practical interest, that the brine does not absorb the flavor of fish, or of meat or, if it does, fails to impart the flavor to other bodies. After over a ton of fish had been frozen in 37.7. cu. ft. of brine, it was filtered and a beef steak and a fowl frozen in it. Neither contracted any detectable taste of fish."

This is natural, for all blood, mucus, etc., that might otherwise be washed off are instantly frozen when the fish strike the brine.

The scientific reasons for the superiority of goods frozen according to Ottesen's method have already been given, avoidance of internal crystallization, and prevention of penetration of salt.

Meat or fish, for example, frozen by this method, differ in many respects from air frozen meat or fish. They are in the first place, not as hard and brittle as air frozen, but have a consistency more like soap or cold wax, yielding slightly when struck a hard blow. Their fins and tails bend rather than break, and the original appearance is maintained. They may be thawed in any way desired, but slow thawing out as at present practised is preferable, for practical reasons. Ottesen frozen fish or meat may be wrapped and shipped long distances without ice, for, although they may thaw out in transit, they remain cold and sweet for many days. When thawed, they are firm and of a wholesome smell and will keep longer than fresh fish, as now marketed.

Low temperatures is the real preservative, not the freezing. If we could reduce the temperature of a fish to say 0°F. without freezing it at all, so much the better, but this is, of course, impossible. Such investigation as has been done on this point suggests that the fish or meat frozen by the Ottesen method are not actually frozen to the same extent that air-frozen fish or meat are, though their temperature may be equally reduced. The rapidity of the process prevents in a measure actual freezing as we know it, because the juices set like jelly, and interfere with the formation of ice The number of B.T.U. necessary to be extracted per ton is therefore smaller.

Fish frozen by this method are excellent for canning, and large gluts can therefore be cared for without the necessity of a huge canning equipment to stand idle a great part of the time.

For the fresh fish trade, there is every reason why fish frozen as above indicated should supplant and supplement the icing of fish as now practiced in this country.

Icing, in the first place cost about as much as chilling or freezing by this method. But icing does not prevent spoiling, it merely prolongs the period during which fish can be eaten, and fish are poorer the longer they are kept on ice. The dealer may therefore be compelled to sell at a loss or dump. If kept frozen the Ottesen fish remain wholesome for a year and longer, and if allowed to thaw they will keep as well as or better than fresh iced fish. The ideal system is to employ the most rapid freezing method immediately after capture, to ship the frozen fish wrapped individually in paper, to store (and re-glaze) the frozen fish for any period desired, and the consumer will in both cases receive better fish than he ever did before.

To freeze in brine was also recommended by Mr. Renderson in Australia in 1912 and experiments made in Leadenhall market in London in 1913. By this method the fish is precooled for about two hours in a room with a temperature of 32°F. after which the fish is immersed in a brine with a temperature of 10°F. The brine is led continuously through a charcoal filter with the object of removing all impurities and smells from the brine, which has a concentration of 15 per cent.

Mr. Renderson does not seem to attach any importance to the osmotic processes or to the formation of ice in the brine, as Mr. Ottesen does, because nothing is mentioned about these points and it is not one of the requirements of the method, consequently penetration of salt takes place.

While Rouart, Ottesen and Renderson use refrigerating machinery for their methods, Henrik Bull has further developed and improved Wallem's freezing method, previously mentioned, whereby Mr. Bull could also take advantage of Ottesen's experiences.

Bull writes as follows about his method :—

"The working of the apparatus is based on the principle that a brinesolution of suitable concentration is continuously brought in lively circulation over ample quantities of fine broken ice. The ice will melt and convey cold to the solution, while this simultaneously will reach the caturation point for ice or the freezing point by the lowering of the temperature. It is, however, necessary to maintain an equal concentration of the brine, for which reason ice and salt must be added in a proportion of about five parts of ice to one part of salt."

Bull's apparatus is shown in Figs. 7 and 8. By separating the mixing space from the freezing space, Bull eliminated the disadvantage experienced by Wallem's method, where the fish was bruised by the mechanical action and by the ice.

C. Freezing in Ice Blocks

In conclusion I may mention this method, which was developed from the endeavour to eliminate the loss in weight experienced by air freezing and to preserve the good appearance of the fish.

Flat galvanized iron pans were used originally, filled with water and fish and placed in a sharp freezer, later directly on coil shelves, whereby the fish were frozen together with the water in a block.

This method had however the disadvantage that fish frequently projected beyond the frozen surface and a considerable time was further required to freeze through.

To eliminate these disadvantages Friedricks employed ice cell shaped galvanized iron pockets, filled from 1/3 to ½ with water and the rest with fish whereupon the cells were placed in a cold brine solution and frozen solid.

Because of the flat shape of the cells the contents is frozen very much quicker, and the blocks, after being removed from the forms, are stored in a cold storage room. The ice serves as a strong glacing which it will take a very long time to evaporate.

This method was employed on a comparatively large scale to freeze eel, and some of these eel blocks have been kept in storage for over two years. The fish have proved to keep in excellent condition both as regards appearance and taste.

The method is, however, expensive to employ for large quantities of fish of different varieties and sizes.

Besides my own experiences in the field of refrigeration and notes made in practice as well as at times of witnessing different tests I am indebted to the following publications for results obtained by the different methods here discussed :—

I. "Department of Scientific and Industrial Research, "Interim Report on Methods of Freezing Fish with "Special Reference to the Handling of Large Quantities "in Gluts, Food Investigation Board, Special Report "1920, London."

II. "Bureau of Fisheries of the Department of Commerce, "Washington, D.C., for Memorando S.61, S.76, S.88 "published, relative to tests carried out."

III. "Dr. Ing. R. Plank and Dr. med. E. Kallert. Die Kon-"servierung von Fischen durch das Gefrierverfahren, "Berlin 1916."

IV. "Bureau of Fisheries, Norway, for different publications "on fish freezing methods and results obtained, 1912 "to 1918."

Modern refrigeration and cold storage is undoubtedly a benefit to all mankind in that it allows of a greater variety of food during all seasons of the year, and when refrigeration has become more generally known in this country the facilities offered will undoubtedly be taken advantage of by our Chinese friends to develop the fisheries along our coast and to obtain a more even distribution of this important food commodity all the year around to the teeming millions of China, not only to the coast population but also to the communities in the distant interior.

The Progress of Science and Engineering in Japan

(Continued from page 559).

nation in the world. It is a nation where every blessed person is thinking of the other fellow. Contrast that with Germany, if you please. Perry, when he went to Japan sixty years ago, or whatever it was, brought back word that he had seen an altruistic nation. That is just as true to-day as when Perry went there.

You know they erected a beautiful, impressive monument to Perry. Once I saw three hundred men from a battleship visit this monument and I was told by an admiral that that was the regular thing, that the seamen from every ship had to go and pay their respects to Perry's monument ; that is a lovely thought and it is just like our good Japanese. They have America on a pinnacle and we must not do anything to disturb that. I believe that as engineers who are trained to deal with facts, not fancies—politics will never do it, politics will drive the two nations apart—as engineers, we should seize the opportunity of drawing us together closer and closer. We are quiet workers. You don't hear about the engineers in the morning newspapers. You do hear a lot about the politicans, but the engineers are doing an effective work in the world. They touch our lives in ten thousand places and it is just the same in Japan, of course. When you have the opportunity, I hope every one of you, personally and individually, will remember to do everything you can to help draw the nations closer together ; and nothing can do more than this idea of going to Japan. You will come back just as enthusiastic over things there as I am, and you will see a great many things that are surprising, a great many things that are built permanently. Talk about the paper houses—forget it ! The great banks and houses and structures in the cities are built just as solidly as they are built anywhere, everything is in the most permanent shape and their interiors right up-to-date.

Now, as to their antagonism to these changes. It is with that just as it is with this persistent lie that we hear about Chinamen being employed in their banks. I was given a dinner by Baron Mitsui—I judge about seventy people were present and I sat at his right. He is the head of a family of bankers with banks in Japan, Indo-China and all through there. They have an office in Philadelphia and in New York. They are also very extensive importers and exporters with a turn-over of about a billion dollars. He said, "No, we have never had a Chinaman employed in any of our banks. Yes, we think we know where that story originated. There was one time when the different provinces of China issued different currency. Some currency would be offered to us that we were not familiar with at all, but we always had a Chinaman somewhere in Tokyo that we could call upon to look it over and see whether we could take it or not. And that is the nearest to any Chinaman in our employ that we ever had."

I hope you will all read Julian Street's "Mysterious Japan," because that represents Japan to-day better than anything I know. Possibly some of you know the author.

I don't think anybody had better opportunity to see the real thoughtful Japanese, the people who use their minds, than I have had. Nothing was too good for me in industrial Japan. Their thought is that what other people can do, they can all do. Just think of it—ninety-eight per cent. of their people, children of school age being included, are able to read. The nearest we can come to that in any state is seventy-four per cent. They are going to get there. I am old-fashioned enough to say that when a fellow is willing to pay the price, that is hard work and industry, he always gets the goods. Nature never cheats us. Those people are going to get the goods in the only way that any of us is going to get it. We are obliged to help them because they are friendly to us and trying to meet us in a most sincere way.

The Progress of Science and Engineering in Japan

By Elmer A. Sperry, President, Sperry Gyroscope Company, Brooklyn, N. Y.

Address before the Engineers' Club of Philadelphia, March 20, 1923

Elmer A. Sperry founded the Sperry Electric Company, Chicago, manufacturers of arc lamps, dynamos, etc.; the Sperry Electric Railway Company, Cleveland; organized and is president of the Sperry Gyroscope Company, New York, manufacturers of gyro compasses, ship and airplane stabilizers, highest intensity searchlights, fire control apparatus, airplane and navigational equipment, etc. Invented products of Sperry Gyroscope Company; erected highest electric beacon in the world on Lake Michigan, 1883; pioneer in electrical mining machinery in U. S., 1888, with steady growth for 35 years; devised electro-chemical processes, detinning process and machinery for making fuse wires; built electric auto; has over 300 patents. Author of many papers and addresses before engineering and technical associations. Member, U. S. Naval Consulting Board, Society of Naval Architects and Marine Engineers, Society of Automotive Engineers, American Society of Mechanical Engineers, Electro-chemical Society (charter member), American Chemical Society, Physical Society, American Institute of Electrical Engineers (charter member), New York Electrical Society. Awarded first prize, Aero Club of France, 1914, for airplane stabilizer; Franklin Medal, Philadelphia, 1914; Collier Trophies, Aero Club of America, 1915 and 1916; decoration (two orders) from last Czar; Grand Prize, Panama Exposition; decoration from Emperor of Japan, 1922.

* * *

LAST autumn there was an unusual honor conferred on me. There are two great engineers' societies in Japan. We have not been understanding them very well, but we understood one thing—that each one of them was going to have its twenty-fifth anniversary—and the Japanese had stood so beautifully, shoulder to shoulder, with us in Washington that the engineers of the United States felt it was up to us to make recognition of this special event. We prepared greetings and congratulations under our great seal, which were entrusted to me to take over there, and so I met two wonderful bodies of engineers in Japan which I want to tell you about.

One of these two groups was the society of mechanical engineers, about four thousand men, and they are much more active than the mechanicals in the United Stetes. They are more like the S. A. E. The other body was more dignified, possibly,—the society of naval architecture of Japan.

Also I have the honor of being a member of the engineering foundation, which represents forty-two thousand members, and I was authorized to represent them as well. So I took over greetings from a great body of American engineers. These occasions in Japan were conducted with such splendid taste—they were not oriental in the slightest degree—there was no tinge of difference in the conduct of those meetings from what we would have in the United States or in England. They were up to the very best level of performance. Everything was in order. They were greeted by representatives of several official divisions of the government, with the usual gold lace adornments, and each read a long document of greetings. By the way, they take these long documents out of an envelope, start to read vertically at the right end and then go on till sometimes some twenty feet have gone down on the floor and there it lies in a large heap at the finish. Then you expect applause, but the whole body sits there in perfect silence until the speaker has laboriously refolded it and put it in the envelope, when everybody applauds. That was a pleasant little surprise.

They applauded these various branches of the government very cordially, but when I presented credentials from three societies in America, I received a great deal more applause than any of them, not for what I said, but for the thought that American engineers stopped long enough to even think about them, our splendid brother engineers in Japan—and they are a wonderful lot.

In meeting with the mechanicals we had eight hundred people in the room and I supposed an interpreter would stand at my shoulder and after I had finished one or two sentences, that he would go on with about there times the amount of words and say it in Japanese. There is a vast difference in their language, as it takes two or three times the number of words to say the same thing. For instance, when counting, they say one, and one one, but when they want to say three they have to put an apology in the word and say "three conglomerated times." Now, if they say three teapots, it would be a different arbitrary word. Just think of a language like that which is so very involved. There I was, not thinking that if I would speak a little slowly to this audience of eight hundred people, they would follow me. It was past belief, but when I did speak rather slowly and imagined I had made a point, their faces brightened up, they laughed at times, and I could see they were following me perfectly. There is a vast difference between the navy and the army of Japan. You are introduced to a general and you are almost invariably asked, "Do you speak German?" They don't speak English at all, but not so at all with the navy. The navy officers speak English almost to a man. They have patterned their navy after the English and quite recently have taken up a great many things that we do in the United States.

After the presentation of my credentials I was taken wonderful care of. I cannot help but smile to think that I went down to Judge Gary, who had spent a week in Japan, and I said, "Judge, how many times did you have to go down on your haunches in Japan?" I didn't know whether I was going to be able to get up again. He said, "I didn't go down on my haunches at all." I was in Japan six or seven weeks. There are very comfortable hotels in all the large centres, where you can have griddle cakes for breakfast if you want them. You are in every way as comfortable as you are at home, so there is no trouble in that respect. If any of you want to take your ladies over, they will enjoy it very much.

Think of what Japan has done. Forty-eight years ago the officials of the government did one hundred per cent. of the thinking for them and they got along to where they thought they ought to have a battleship. I think they thought they saw Russia making gestures towards them, but whatever they saw, they said, "We ought to have a battleship." So it was some twenty-five years ago that they contracted for their first battleship from England, a little 12,000-ton ship, and sent many people over there to see it built, inspected, and so on. The Mikado cut down his household expenses and every officer—I met two or three who were then officers in the government—gave up ten per cent. of his salary, and they gave up enough to pay England for that first battleship. Now then, mark the progress. Do you know, within seven years they were building their own battleships and much larger ones than we are.

It was only a short time ago, in October, last year, that they celebrated the fiftieth anniversary of the introduction of western civilization in Japan. Now there is a curve of advance that is twice as steep as any curve we know of in America, and ten times as great us anything we have in Europe.

Let me tell you a little about their tools. In the great dockyard at Kobe they have a navy yard at least four times as large as our largest navy yard, at New York, for instance. There is a yard which has a great 25-ton furnace. They have an enormous steel plant where they make the steel and roll the ship's plate. They also make their own guns. There is a gun factory that is perfectly wonderful, because it is made to withstand earthquakes, which is no small job, especially when you consider how high those great buildings have to be. They are stupendous. If we went into a building forty-five feet high, the same as we have in some of our works, we would say it was a high building. But there is one in Japan one hundred and twenty-five feet high in the clear under the crane (there are two great big cranes), beautiful steel work, and steel and glass clean to the top. It is a very impressive sight because that great lattice work is just as tough as anything you can find in America or anywhere in any bridge work.

I was taken through many of the industrial plants and navy yards. They use my apparatus in the navy and the government honored me and gave me great distinction because they imagined I helped them in their need, so I was taken care of as few Americans are. An admiral took me through the gun factory I mentioned, where they had a gun tube hanging that had received certain heat treatment. I said, "You don't mean to say that you heat treat that gun tube? Just think of the pains that will have to be taken in trying to get that in straight. You don't go deliberately and put a curl in its tail by getting it up to a very high cherry red and putting it through a series of treatment?" "Yes," he said, "we found out how to do it although it has taken us quite a while." I said, "What is that still hanging for?" "Well," he said, "we got through rather late last night, as we were showing some of your engineers how to do it." The Japanese engineers have gone on pretty well to attain a position like that.

And so it was in their forge shop. The Japanese seem to have the idea of taking a lot of new things where sometimes we may question their wisdom, but they seem to take them, use them and get the blessings of them long before a great many other nations do. You see among them the very lastest things.

Take the locomotive, for instance. Here we are struggling with five generations of valve gears in the locomotive—at least five generations. You go over to Japan and you are struck with the fact that every locomotive has the very latest, the Janney valve gear, and you do not see any other. On my way home from Japan, coming out of Chicago on the Twentieth Century, the Chicago-Broadway Limited came along and there was the Pennsylvania Ltd., and they had two locomotives drawing the train; they had two kinds of valve gear on them—one was the Janney gear and the other was not—but over in Japan you see just the latest in everything.

When I had been on Japanese soil only about thirty minutes, coming up from the port of Yokohama to Tokyo, I saw at least four great big, high-transmission lines. That was my first encounter. I didn't stop at the port long enough to see the buildings there, but the first impression I got was of the finest kind of construction of high-tension lines. Great big steel bars on concrete pillars, just the finest construction that money can buy and the very latest. That was quite in contrast with my experience in coming over the track on the St. Paul road, where we saw high-tension lines that furnish those big power stations. There it is a wooden pole line and there isn't a straight pole on the whole line as far as I could see. In contrast with that, I was not prepared to see the beautiful things that I saw in Japan. They have three times the high-tension transmission lines per capita that we have.

Japan sends delegations to the United States and to the continent and we see them wandering around, saying not a word; but don't lay that up against them. That is characteristic of the Japanese. You must remember they are taught from infancy that it is better to walk a yard than to talk a mile. They are taught to show entirely by their deeds what kind of fellows they are, rather than by anything that they say. So they don't say much but they have deeds, I tell you, just as true as the word. These delegations that come to the United States and look around—what are they taking home? They see a great many things. As a matter of fact, they reject one hundred things for every one that they take back. They are very discerning and seem to know the difference between the good and the bad, using the latest things while we are still struggling with the old.

If you want a hotel that is lighted and heated with electricity and cooks by electricity, you go to Niagara Falls, but if you want one where the water is also heated by electricity, you have to go to Tokyo.

Japan is very mountainous. No one ever told me that Japan was one long mountain range, although they cultivate those mountains almost to the top. They build a forty-foot wall to make an eight-foot wide garden. If a man fell off, he would break his neck. But there they are—men and women—tilling those little bits of gardens up there, and still they say that only one-tenth of the area is cultivated, the rest being rocks. It has taken toll from that nation for the last ten thousand years, but, of course, it has put backbone into the nation and iron into their blood. They cannot struggle against tremendous difficulties continually, as they have, without reflecting on the race. Had I not left Tokyo, the only plain they have, and gone into the mountain district, I don't think I would ever have understood what I saw in the faces of the Japanese people.

And they are such workers. They work while we are asleep. We have had a great many Japanese in our works and that is the experience we have had with them. They will tackle anything and will keep it up until they get absolute mastery of the thing. Our compasses in the Japanese navy are giving just as good results as in our navy; much finer than in England, France and Italy. We have never sent an expert over to Japan, but we have sent experts in relays to other places to get those compasses working. Never an expert to Japan—they picked it up all by themselves.

The Westinghouse Company have had the same experience. They sold France their underground system and before they could get it into satisfactory operation, they had sent the third relay of engineers to teach the Frenchmen how to work the thing. They sold the same equipment and nearly as many of them to Japan. I have ridden on the line into Tokyo and they make the same speed as we do on our suburban lines in the United States and they are well cared for. Westinghouse held four experts ready to go over just as soon as the stuff was unpacked and ready to remove, but the Japanese never called for one of them. Finally, they said, "We are sending So-and-So." The reply was, "We are not ready yet," and by and by the payments were received and the lines were in full operation and working splendidly.

They have a large number of engineers in Japan. Just think! You can get a 13-foot forging in Bethlehem or you can get a 15-ft. forging in England, but if you want anything larger, you have to go to Japan. I told Charlie Schwab one day about one of their large machines and he said, "Yes, I made that." I said, "Yes, I saw the one you built—it was very much smaller." This is a great two-cylinder press that they built themselves and they know how to handle it. I saw beautiful forgings that they turned out. They could handle that press and all the other presses in that great place just as well as we can. They are more careful and it seemed to me that they do their work more thoroughly than we do.

At their dock yards I have seen cargo after cargo of pig iron, fine Swedish iron, and they take all the sulphur and phosphorus out themselves and make it as good as gold ore. They take that pig iron in at one end of the dock yard and turn out a 33,000-ton battleship at the other.

When you go to Japan—and I hope you will go—you will get a right royal welcome. I hope the Mechanicals and representatives of some of our other bodies will join you and go there in a mass. A most enthusiastic welcome awaits you in more than one way. That is one of the things where we ought to be proud enough to say to our good Japanese brethren, "Let us go more than half way once." Let us feel what it is to be grateful and courteous and fine.

And then I must tell you about the workmen. I saw the finest lot of team-work there that I have seen in my life. I have seen workmen in our country and have had to depend on them. It is my job to get them in and keep them working harmoniously and in teams. If you get four or five Japanese working together, they sing. They have a funny song that you hear the street sweepers sing when they are working at night, a little simple ditty that goes on and on forever, but in that way they get close together in their team-work.

One time I went down into the under regions of a great hotel that is in process of being built, to hear this song. I said to Mrs. Sperry, "I am going down to see what part that song plays in their work." I followed the sound and finally saw a gang of men bringing in a great heavy elevator on long skids. I turned a corner and came upon them suddenly. In a case like that, in America, your workmen straighten up and think it is a good excuse to loaf, but they didn't do that. Finally I put my hand to my ear. There they were singing this song and working. They knew I wasn't there to make fun of them. They knew I was there to hear about this song. Instead of standing up, they went back to the job again without any command from the foreman, but they didn't sing. Then I touched my ear again, as if listening to them, and they all started up their song and smiled as cheerfully as before.

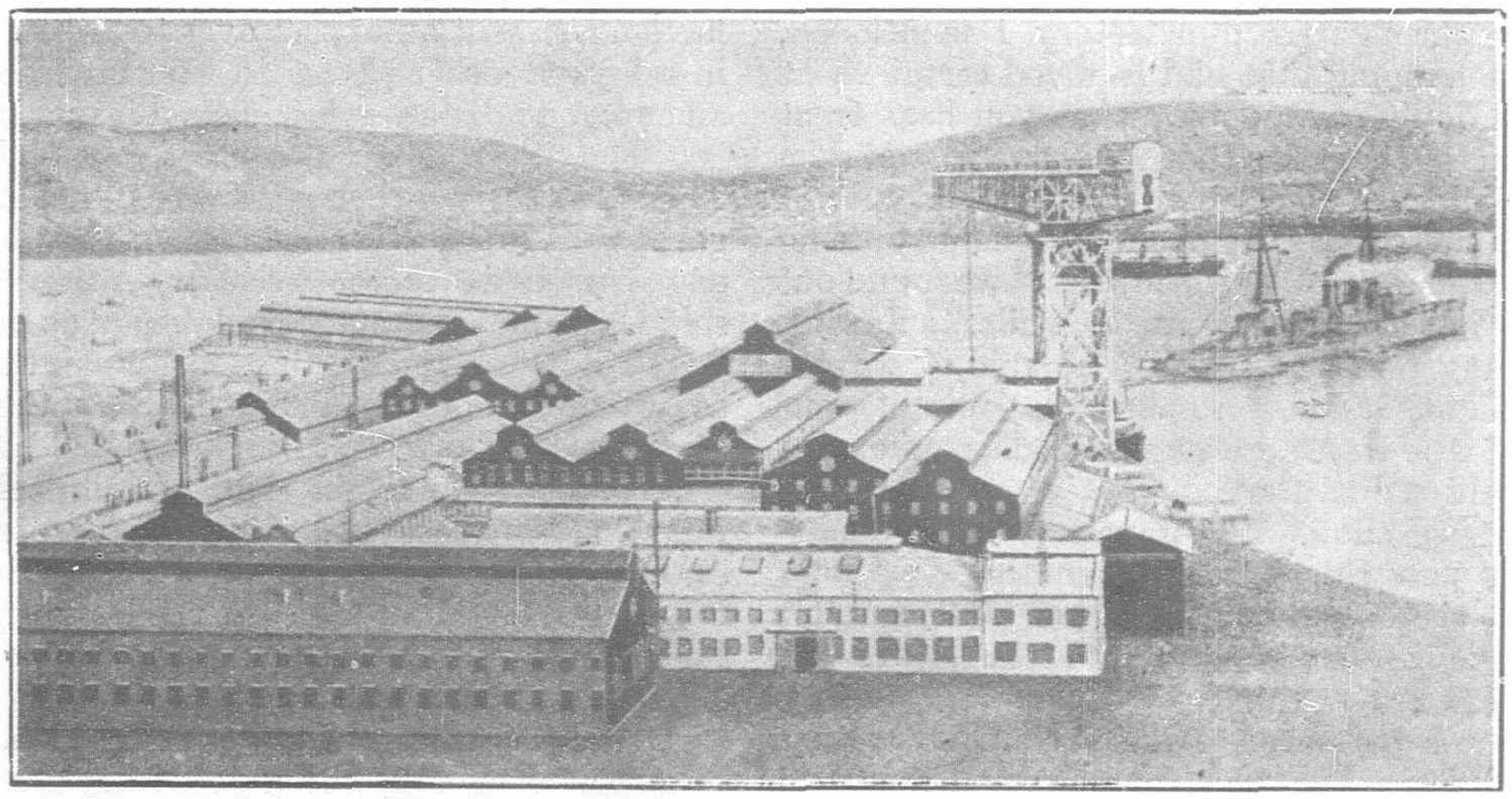
You see smiles from one end of that realm to the other. They are cheerful workers and I think they are the most courteous

(Continued on page 557).

Japan's Electrical Development

The Mitsubishi-Parsons Turbo-Alternators

FOREMOST in the development of electrical machinery in Japan stands the Mitusbishi Company whose works at Nagasaki have been turning out electrical apparatus for many years. In the construction of large units this concern has had remarkable success and many of the important plants in Japan are equipped with turbines and alternators made at their works. The Mitsubishi Company manufacture turbo-alternators at their Nagasaki Works under license from C. A. Parsons & Company, Ltd. of Newcastle-on-Tyne, while at their Kobe Works they manufacture the Stal turbine. In perfecting the mechanical and electrical designs of these alternators, advantages have been taken of the latest Parson's patents and special attention given to the thorough and efficient ventilation of all parts, and the finished machines are subjected to rigorous tests and inspection.


View of Machinery Department Nagasaki Works of the Mitsubishi Zosen Kaisha, Ltd.

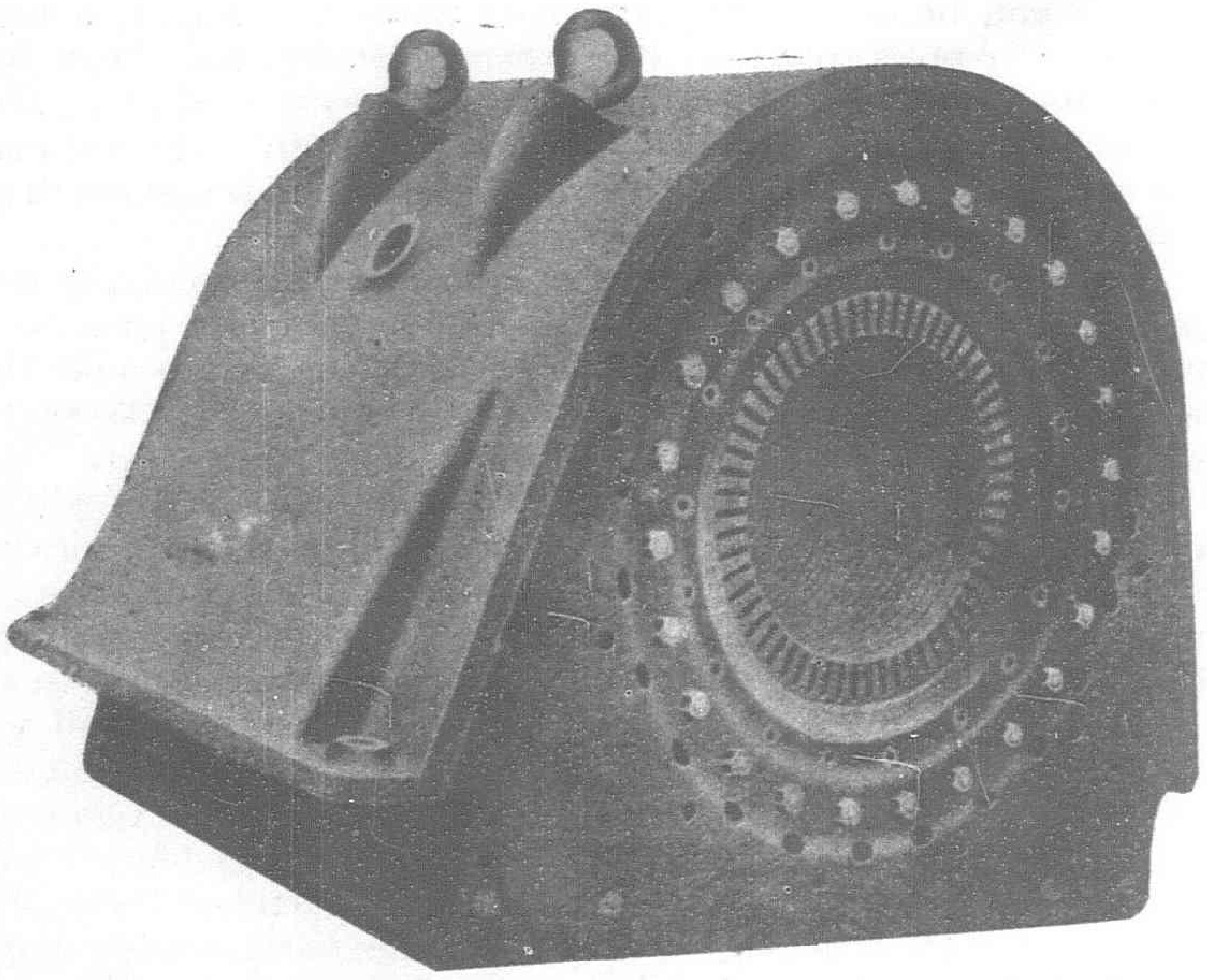


Fig. 1. Alternator Showing the Arrangement of Stator Core Stampings

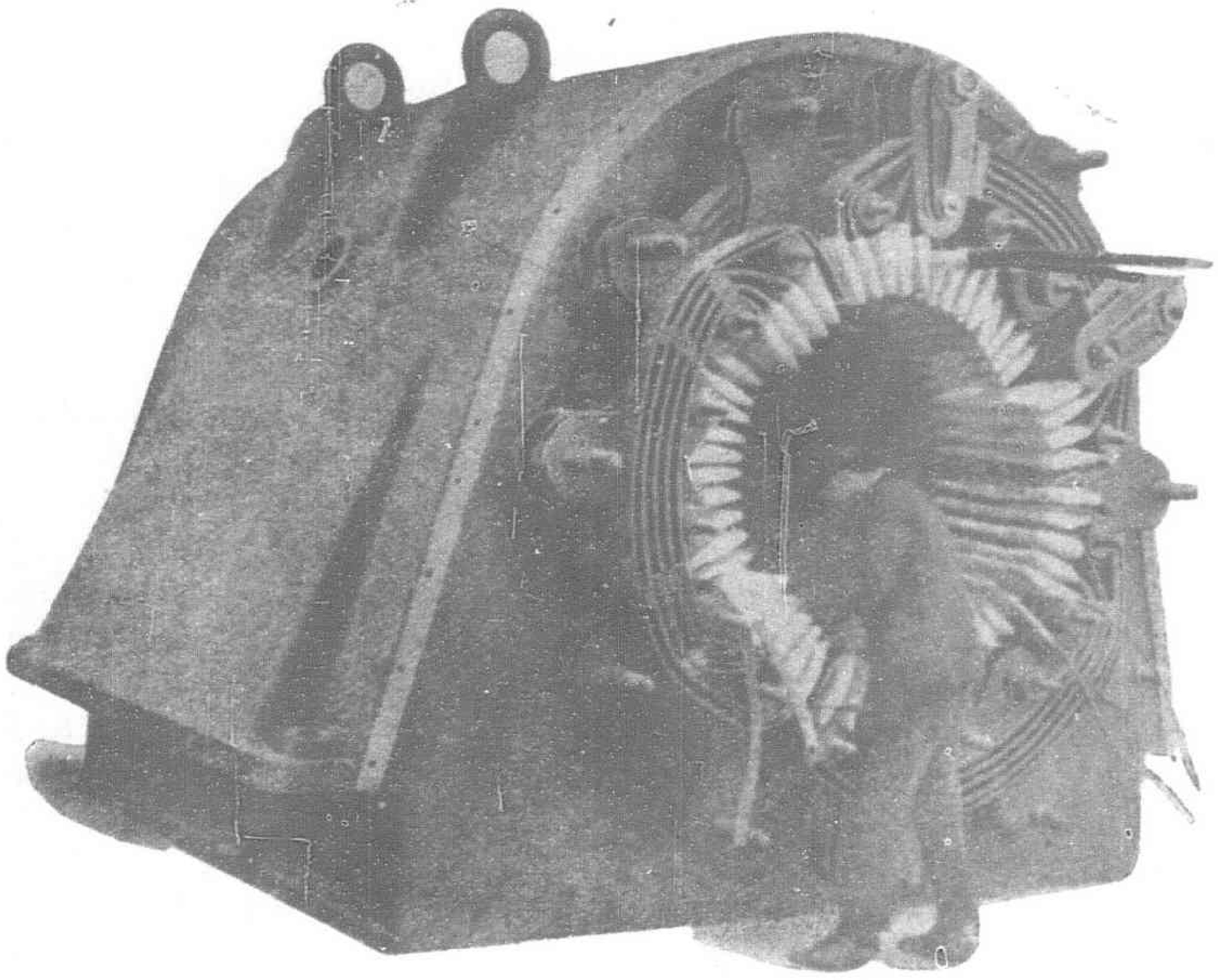


Fig. 2. Alternator Showing the Stator Winding in Building

The alternators made at the Nagasaki Works are of the enclosed ventilated type with revolving magnetic field, with stators of cast iron. The ore is built up of stampings of high permeability and low hysteresis steel sheets, insulated with paper. The stator windings are tunnel wound in suitably shaped slots insulated by heavy mica and fibrous tubes built around the conductors. The end windings are strongly stayed and supported to enable the windings to withstand any ordinary shock by short circuits or other accidental faults.

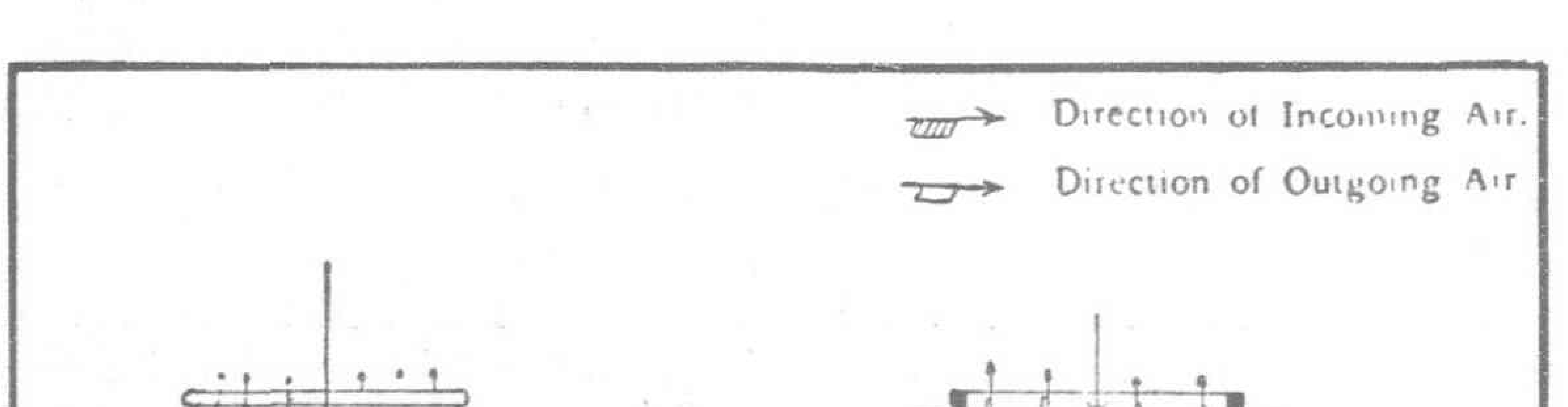


Fig. 4. Arrangement Showing the Air Passages of Self-Ventilated Alternator

The rotor body is of special forged high tensile steel, with windings of the barrel type, embedded in slots distributed around the periphery. Along the body of the rotor the windings are held in place by bronze or gun-metal wedges securely keyed to the rotor teeth, while the end windings are held by massive end caps of bronze or steel. The insulation is chiefly of mica, with fibrous materials for retaining the mica. The end caps are so constructed that when forced into position, they hold the coils tightly and prevent any movement of the windings.

The collector rings are of seamless forged steel shrunk on to the shaft over mica bushes and the connections carefully insulated. The burshes are fixed in a spring type holder fitted with catches so that the pressure can be relased and any one of the brushes removed while the machine is in operation. Grooves are provided at each end of the rotor to attach balance weights quickly and easily, and all parts of the rotor carefully balanced before assem-

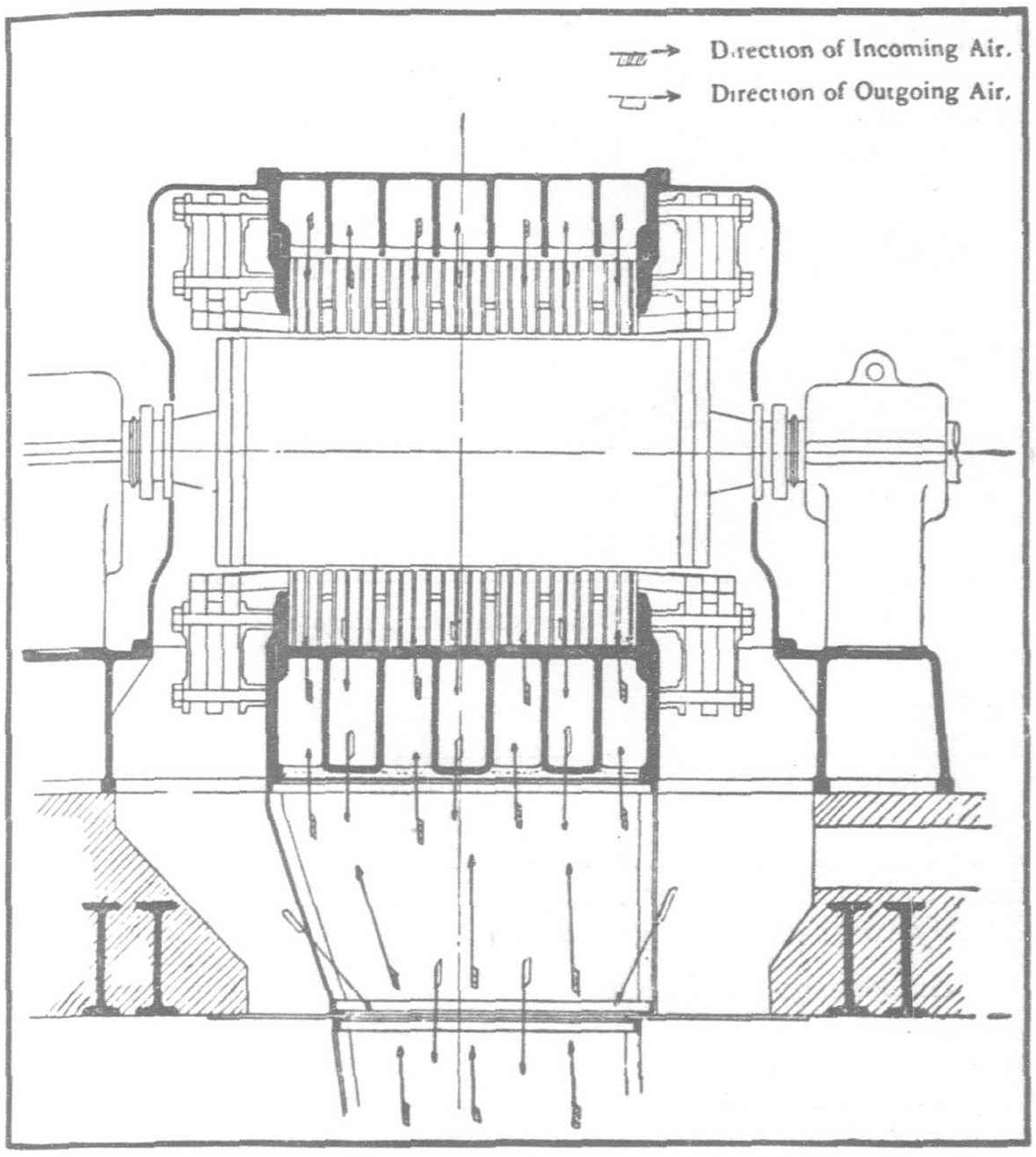


Fig. 5. Arrangement Showing the Elevation of the Air Passages of Forced-ventilated Alternator

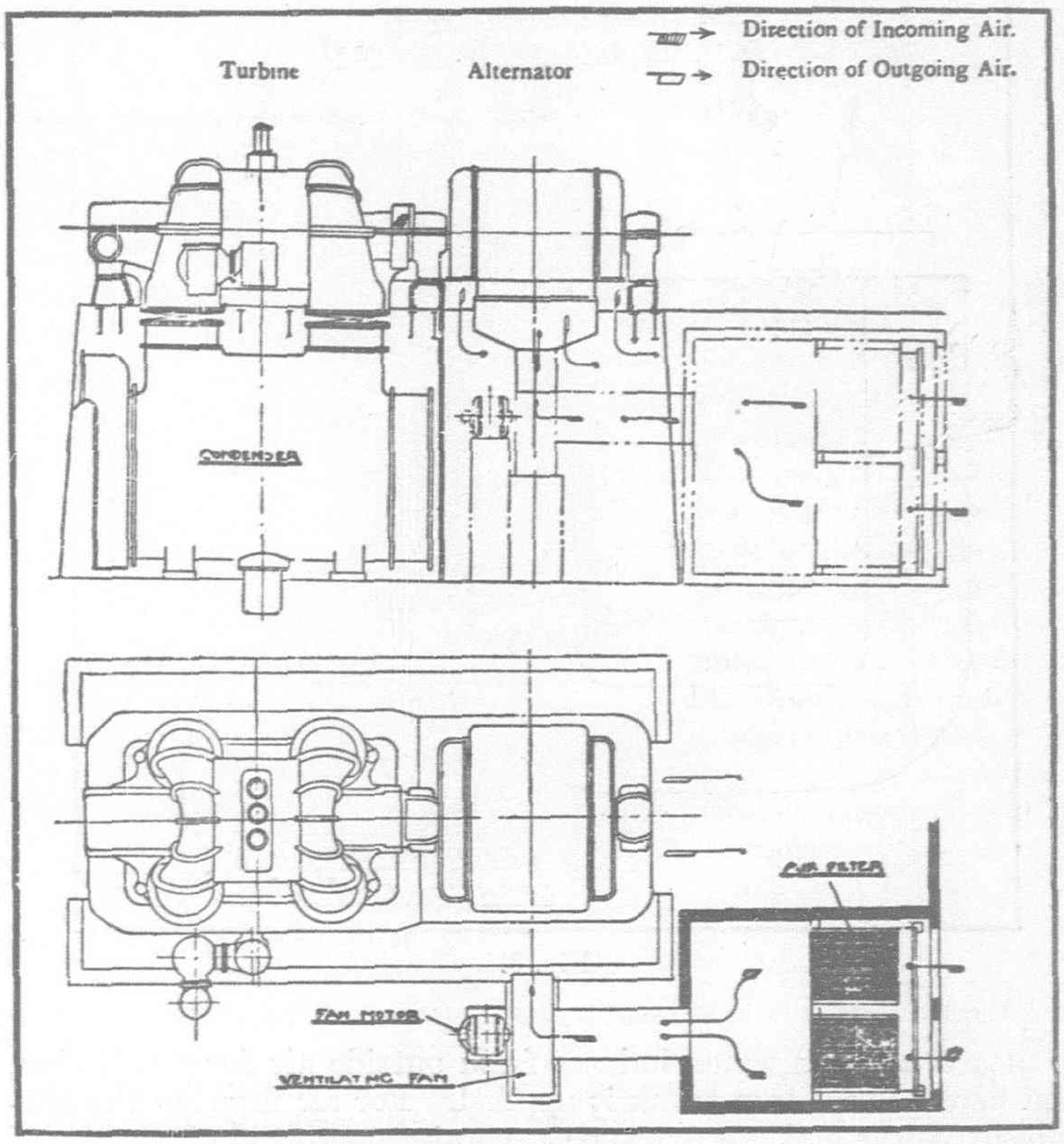


Fig. 7. Arrangement of Forced-ventilated Turbo-Alternator

bling. After completion the rotor is run up to 20 per cent. over its normal speed and carefully balanced.

Self-ventilated and forced ventilation are employed in the construction of these alternators. Air is forced in from the openings at one side of the bottom of the frame to the pressure compartments by an external fan. Passing through the ventilation ducts and holes of the stator core, the air is forced out to the neighboring exhaust compartments and goes away to the outside of the casing from the openings at the other side of the bottom of the frame. Tyis form is used for the machines of large capacities, because of the efficient ventilation and consequent saving of machine size. The patented Mitsubishi ordnance fans are used in connection with this type of ventilation.

To provide against fine dust or moisture, it is often necessary

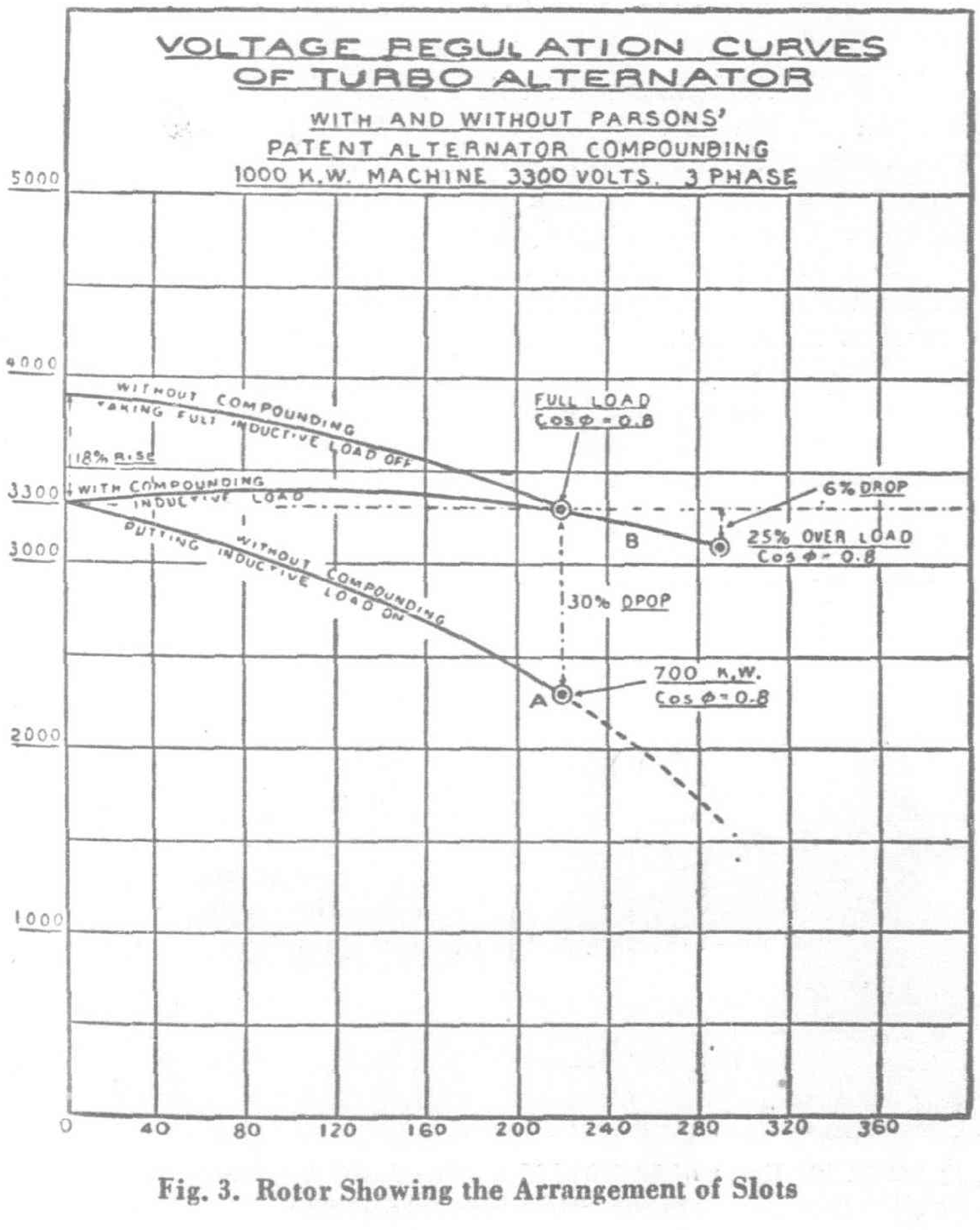


Fig. 3. Rotor Showing the Arrangement of Slots

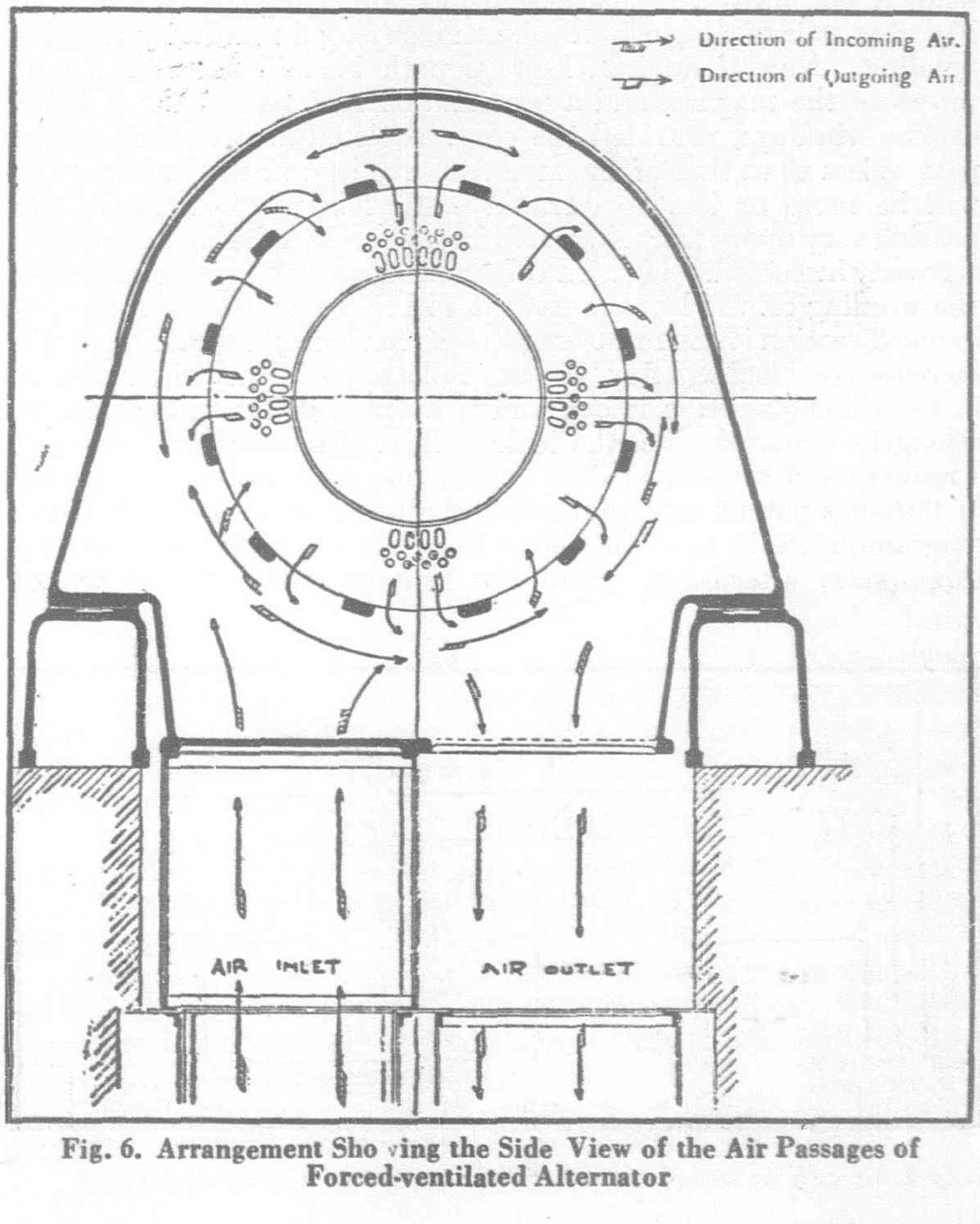


Fig. 6. Arrangement Showing the Side View of the Air Passages of Forced-ventilated Alternator

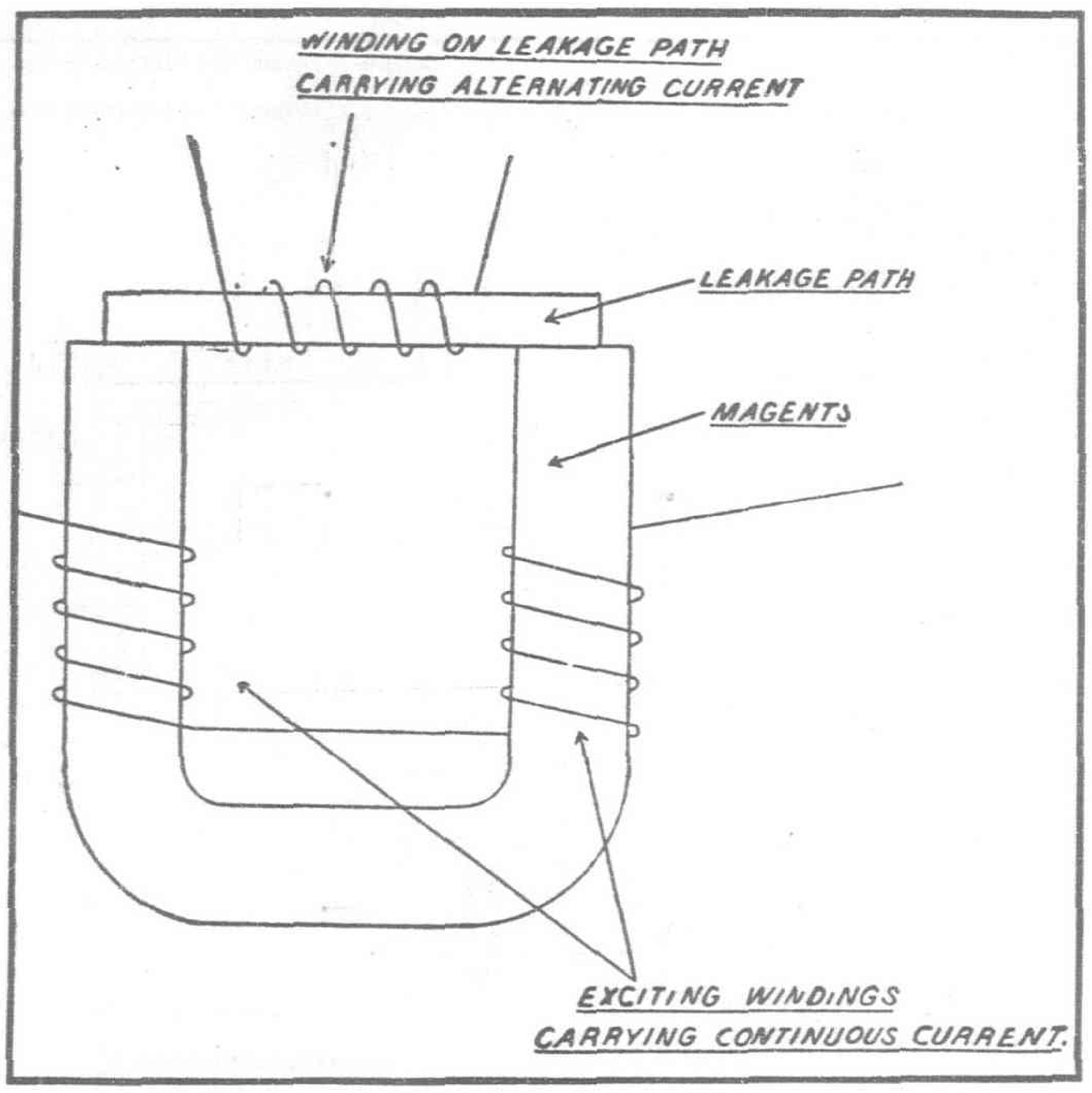


Fig. 8.

to attach a trunk which induces fresh outside air for ventilation, and here a sheet iron trunk is applied. For air filtering the Mitsubishi Works makes a dry type apparatus composed of pockets of closely woven cotton cloth in the form of rectangular envelopes with one open end.

The standard patterns of these turbo-alternators turned out at the Nagasaki Works range from 500 kilowatts (625 K. V. A.) to 20,000 kilowatts (25,000 K. V. A.) with a power factor of 80 per cent. and voltages ranging from 1,100 to 11,000, and 25, 50 and 60 cycles. To minimize the voltage variations due to sudden and large fluctuations of load, Parson's compounding method is provided for the exciter. This apparatus depends upon the simple fact that while an alternating current cannot directly produce an undirectional field, it can have a strong action in diminishing such a field. In Fig. 8, a pair of magnets are shown carrying an ordinary exciting winding. Now if an iron leakage path be laid across the pole pieces of the magnet, and a powerful current passed through the exciter windings, provided the cross sectional area of the leakage path is less than that of the magnets, the iron of the leakage path will be more or less "saturated"--that is, will be incapable of passing very many more lines of force, even when the exciter current is greatly increased. Now if an alternating current is passed through the winding on the leakage path it will be seen that when passing in one direction it cannot, owing to the iron being staurated, greatly increase the "leakage flux" in the leakage path, but when passing in the other direction it can and will—provided it be of sufficient strength—greatly reduce the leakage flux. Hence the net result is a reduction of the leakage flux. It is this principle that is applied in Parson's patent compound wound alternator, and Fig. 9 shows diagrammatically how the connections are made in the case of a three-phase alternator. Here the leakage paths, which are of laminated iron, are seen bridging the magnets of the exciter, and consequently diverting a large number of lines of force which would otherwise pass through the exciter armature.

The effect of this is to keep the voltage of the exciter lower than it would be if the leakage paths were not in position. The arrangement being three phase, there are three paths, each carrying a winding energized by the current in one phase. As described for Fig. 8, when the load comes on the alternator, the "leakage flux" in the "leakage paths" is checked back, and the flux through the exciter armature consequently increased, causing a rise in voltage of the exciter and thus automatically increasing the excitation of the alternator, the action being practically instantaneous, since the increase of current due to the load coming on is used directly to effect the regulation.

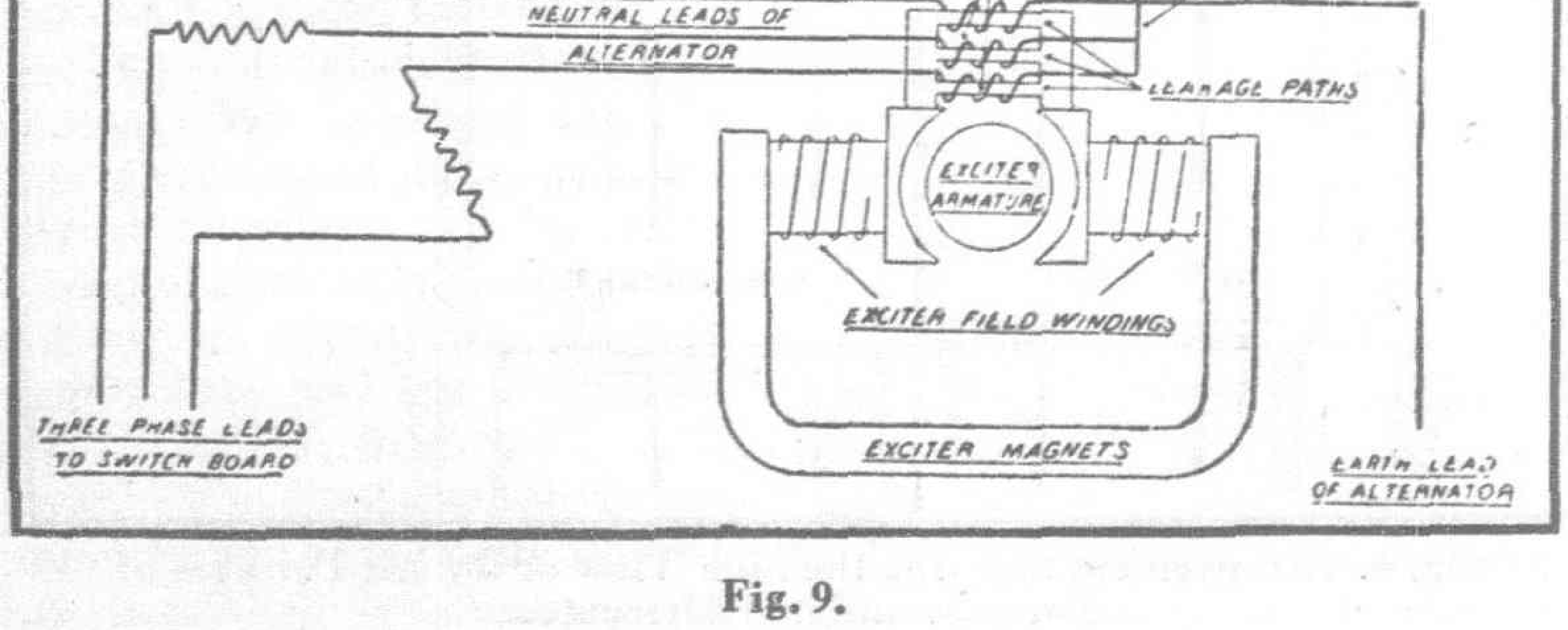


Fig. 9.

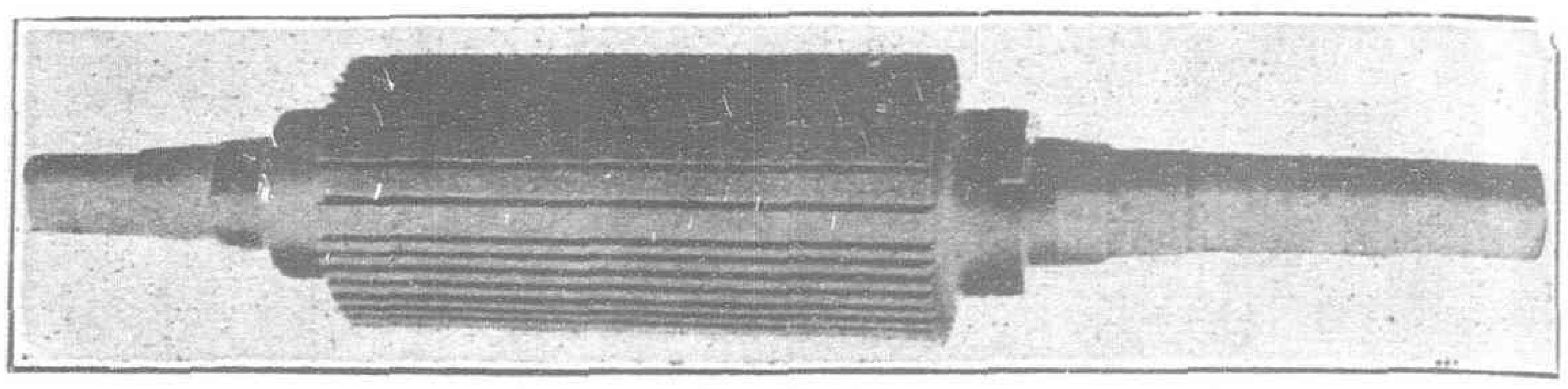


Fig. 10. Amperes per Phase

The leakage path windings are placed between the windings of the alternator and its neutral point, which is usually either "earthed" or at a potential differing but little from earth, but in spite of this they are insulated for the full working voltage of the alternator. In a few special cases current transformers are used instead of passing the main current round the leakage paths. Fig. 10, shows the voltage regulation of an alternator under varying conditions, with and without the leakage path compounding. The curve marked A shows the effect on the voltage when a heavily inductive load is thrown on : by the time the full-load current of 220 amperes is reached the voltage has fallen to 2,300, so that the load on the plant is really only 700 k.w., yet the voltage has fallen from 3,300. The curve marked B shows that when the compounding is in use the voltage remains practically constant. If desired, however, the compounding can be arranged to raise the voltage automatically as the load comes on : this is common in C. C. traction generators, and is useful when it is desired to compensate for voltage drop in feeders.

A further advantage of this system of voltage regulation is that the alternator may be designed for a much smaller short-circuit current. It is well known that where close inherent regulation is required of an alternator—that is, when it is required that its voltage shall remain as steady as possible with varying loads—the current which passes when the alternator is accidentally short circuited is very much greater than in the case of a machine designed for poorer regulation. These heavy short circuit currents not only cause considerably more damage at the point of breakdown, but also are liable to damage the windings of the alternator, and cases have been known where the main cable conveying the current have been wrenched from their supports. It is a fact that by using this method of compounding an alternator the short circuit current which passes when the machine is short circuited can be easily reduced by one-third, and the Parson's compound wound alter-

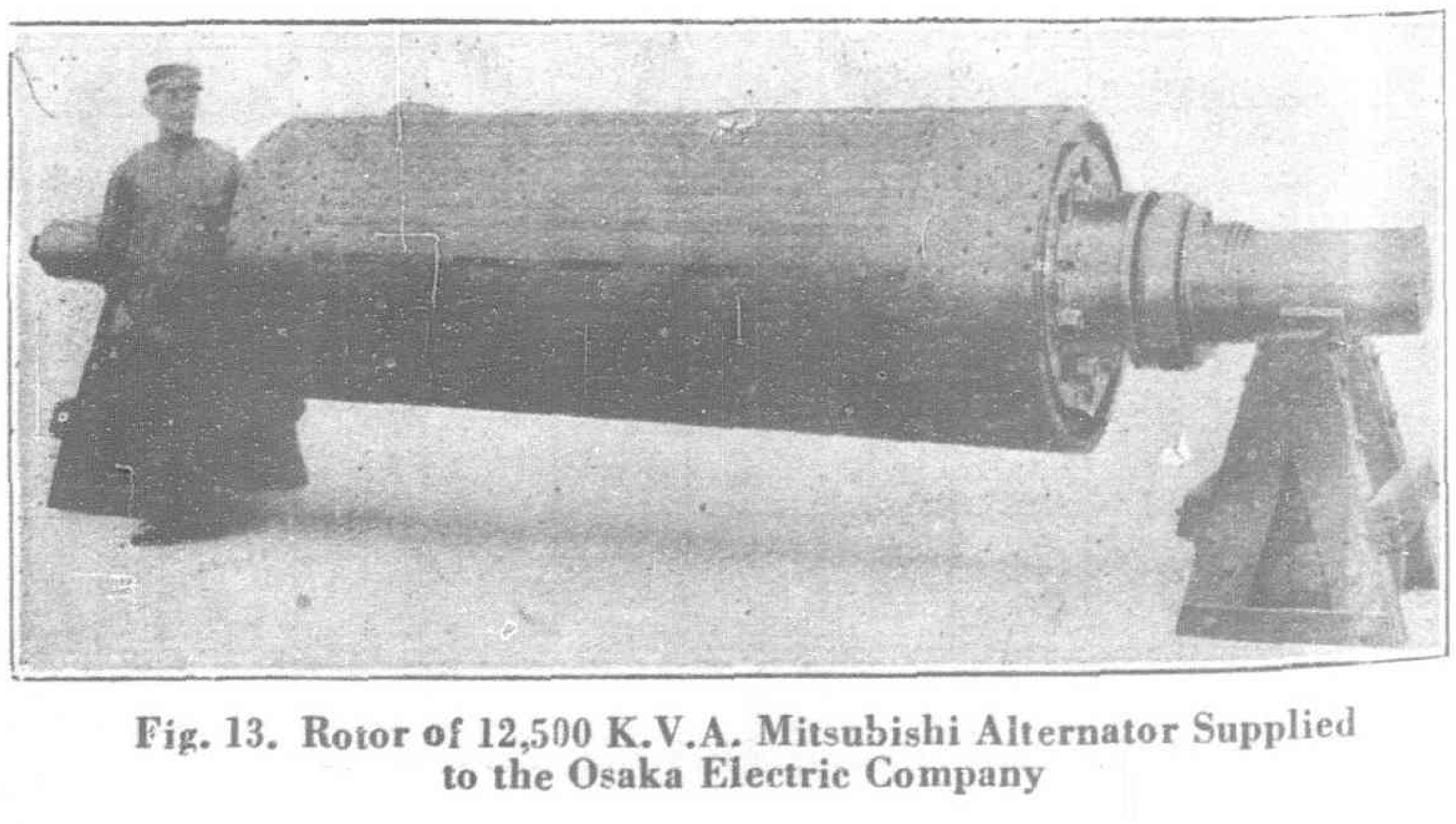


Fig. 13. Rotor of 12,500 K.V.A. Mitsubishi Alternator Supplied to the Osaka Electric Company

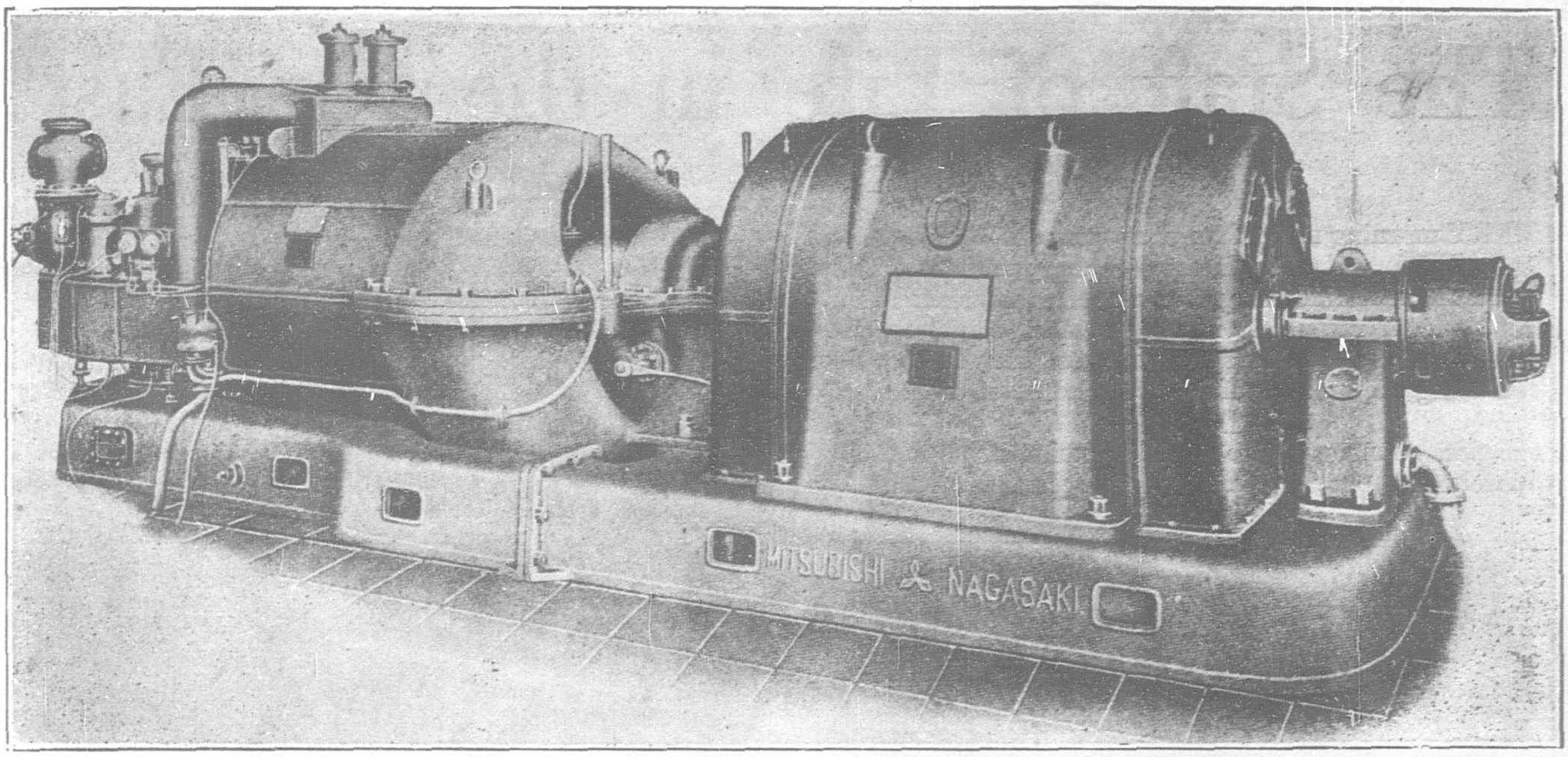


Fig. 14. K.V.A. Mitsubishi Turbo-Alternator Supplied to the Nagoya Dento Kaisha : 3 Phase, 60 Cycles, 11,000 Volts, 1,800 R.P.M., 80 per cent. Power Factor, with Direct-Coupled Exciter

nators are designed to take advantage of this. All extra apparatus required for a compounded alternator of this type is entirely electromagnetic—there are no moving parts whatever, nor any electrical contacts to be made and broken, nor are there any complications such as solenoids and electrical condensers. There is no commutator to change the alternating into direct current, and all the parts required for the compounding are fixed on the exciter. Thus, if in spite of all the great simplicity of these parts, trouble should occur in this part of the machine, it is only a matter of a very few minutes to completely remove the compounding apparatus, when the machine can be run as an ordinary uncompounded plant. It has been proved by actual trial that there is no difficulty in running in parallel machines fitted with this device : no extra complications, such as equalizing wires, are involved, and compounded alternators are also running satisfactorily in parallel with uncompounded plants.

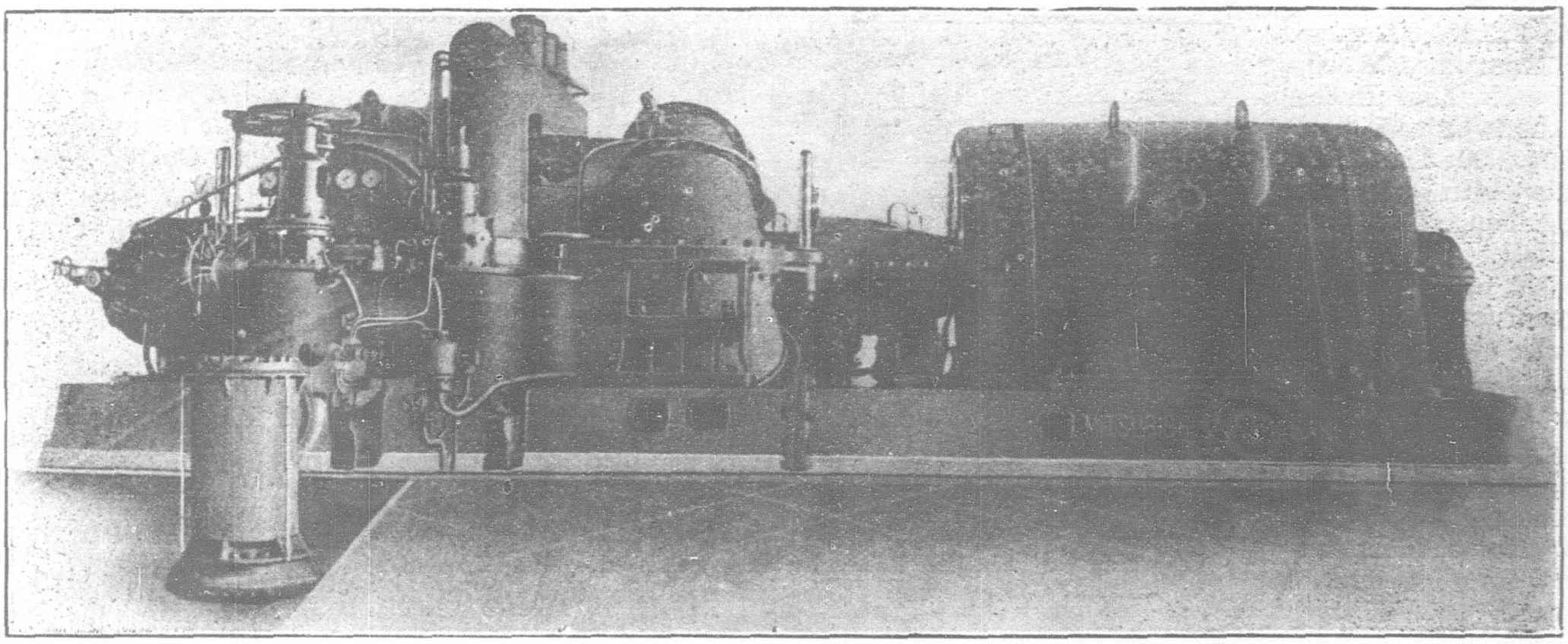


Fig. 15. One of 4 sets of 12,500 K.V.A. Mitsubishi Turbo-Alternators Supplied to the Osaka Dento Kaisha, 3 Phase, 60 Cycles, 11,007 Volts, 1,800 r.p.m., 80 per cent. Power Factor

Frazar & Company Expands

Announcement was made on June 21 in New York, of the consolidation of the business of Cowdrey & Winkhaus with that of Frazar & Co.

Cowdrey & Winkhaus for the past sixteen years has conducted a general exporting business with South America, and particularly in Brazil and the River Plate region.

Frazar & Co. are among the pioneers in American foreign trade, Everett W. Frazar, one of the present members of the firm, being the third generation of the family in the business. His grandfather, Captain George Frazar, began trading between New England and Chinese ports as early as 1834, being succeeded by his son, Everett Frazar, who permanently established the firm in Shanghai in 1856. Two years later he joined Commodore Perry on the latter's second expedition to Japan, to which country he subsequently extended his commercial activities. On his death his son, Everett Welles Frazar, continued the business, establishing permanent offices in all important Japanese cities and in China, Korea and Formosa.

Among the early accomplishments of the firm during the development period of Japan may be mentioned the importation of the first electric dynamo, the first American locomotive and the first phonograph.

Though primarily engaged in the Far East, in recent years the business has been extended to Europe, through officials located in France and Switzerland. In addition to New York, branches are maintained in San Francisco and Seattle.

The consolidation with the Cowdrey & Winkhaus interests provides new and additional facilities in South America.

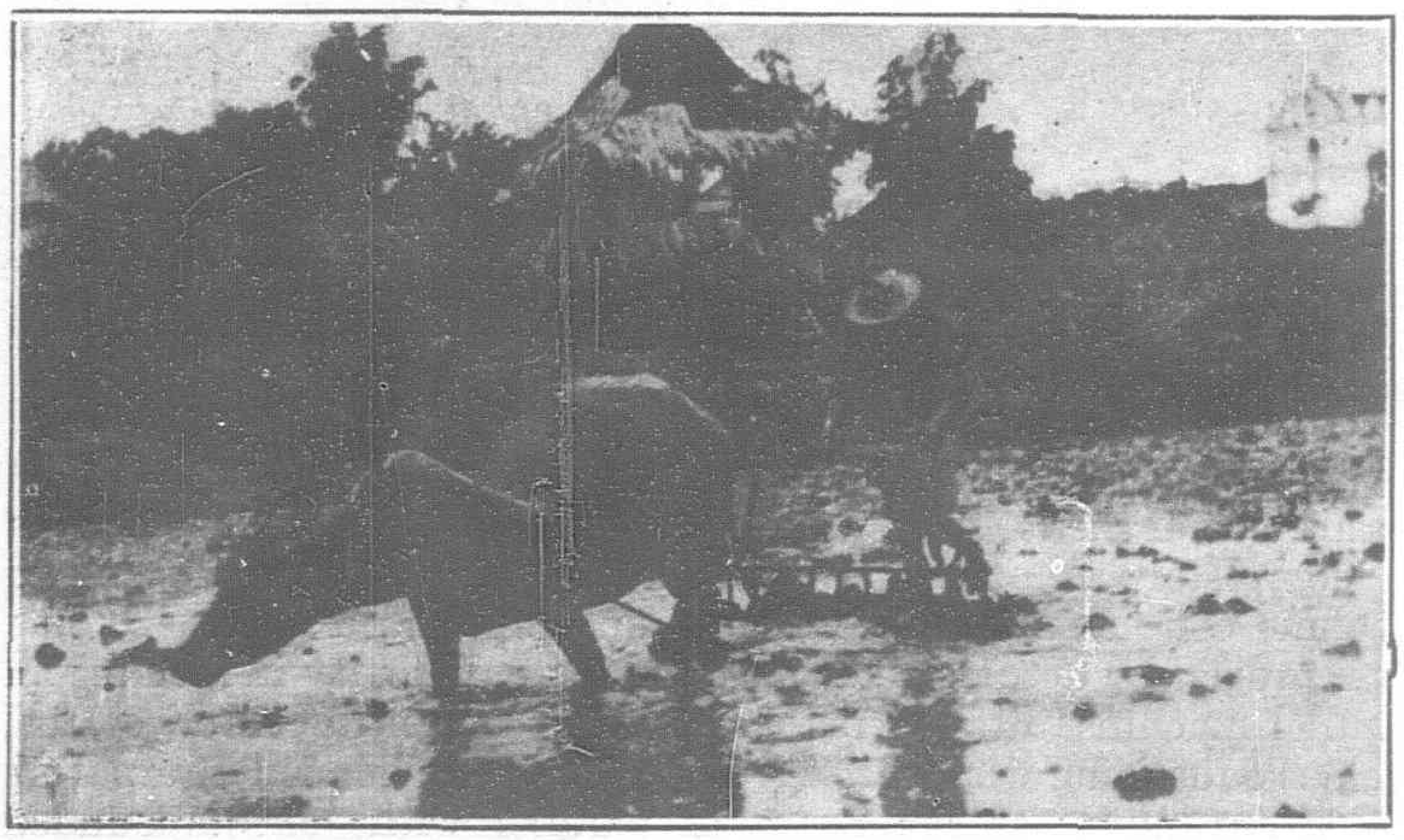
The business will be continued under the name of Frazar & Co.

The Staff of Life in the Far East

By Kilmer O. Moe

EVERY morning more than sixty per cent. of the world's population wakes up hungry—hungry for rice. From time immemorial this grain has been the principal food of oriental races. It is the greatest cereal food on earth. Let us consider for a moment the vital problem of filling the mouths of this vast horde of oriental rice eaters.

China, the first country in the world in point of population; has approximately 455,000,000 people. The Indian empire is credited with 325,000,000 more. Japan with Korea, has 78,500,000. The Dutch East Indies, 42,000,000. Indo-China is credited with 15,000,000; The Philippine Islands with at least 10,000,000; Siam, 9,600,000; Federated Malay States with about 4,000,000, not to mention Persia, Afghanistan, Turkestan and others which are also within the oriental radius.



Planting Time. The soft mud is worked up into a mixture that resembles motar into which the rice seedlings are transplanted.

A bountiful harvest on a rice farm in Central Luzon. Each tenant has a stack of his own.

Here we have almost one thousand million of the world's population which under ordinary circumstances is increasing at the rate of fifty millions annually. What is to become of this vast annual increase, these additional mouths that need food, when the food supply now is far from adequate? Modern education, transportation and sanitation that increase desires are adding their urge for more rice to feed the hungry masses rather than adding to the supply.

The countless millions that inhabit the Far East constitute a great volume of hunger and unrest, and their ceaseless urge will determine the ultimate struggle. This stupendous and shadowy mass comprising, as it does, over half of the human race has potentialities in the aggregate that statesmen will do well to consider.

Preparing the threshing floor. A mixture of carabao dung and mud is used. This, when dried, makes a mat from which the rice grains may be swept up with ease.

Platitudes will not stop mob hunger. It will need the broadest kind of leadership to place the food needs of the future on a satisfactory basis.

Indescribable poverty and daily drudgery enable the myriads of the Orient barely to keep body and soul together. Among these millions a cessation of labor means that the flicker of life burns low. Their lands are fertilized with the remains of untold millions who were born, lived, died and were buried in poverty. Consult the records of forty centuries.

It is of the highest importance, therefore, that every nation

Winnowing the grain is a task usually left to the women.

Spreading the sheaves on the threshing floor. The hexagoual roller is pulled by a carabao.

in the Far East take stock of its potentialities in relation to its national existence with especial regard to the alimentation of its inhabitants. This will be the supreme test for the national welfare of oriental countries.

The great war very forcibly brought home to mankind the fundamental fact that the only possibility of survival for men as well as nations is to employ every possible means of increasing the sources of alimentation in order to safeguard those resources that tend to insure the possibility of sustaining the nation. A country that does not take this vital truth into consideration is building upon the sand. Its awakening will be rude and its final struggle will be tragic.

The post-war strife now taking place in Europe is, in the last analysis, one of insuring the staff of life for posterity. Occidental civilization is so very complicated that this purpose is hidden under a mass of detail, but the end of it all is really to make sure of three meals a day and a place to sleep for the nationals of the various contending nations. In the Orient, however, the issue is plain. Perenial scarcity of food enough to barely sustain life is here becoming the gravest of problems. It is like the sun, none but the blind can fail to see. Every day the world seems to grow smaller; every day mankind is being jostled and crowded closer.

The Available Supply of Rice

The orient simply must have rice. No one has so far been able to discover a substitute. Forty countries of the world now produce rice but only eleven of these have a surplus in good years, and only three of the eleven—Burma, Siam and Indo-China export rice regularly and in quantity. In the best of times there is no great margin of production over requirement of this commodity. The surplus in three small countries is all that stands between the oriental millions and hunger. Half of the population of the world is at the mercy of a bad harvest.

China, Japan, Java and the greater part of India have reached their limit in production so far as extension of area devoted to the cereal is concerned. The only solution left them is that of increasing production through means of irrigation, fertilization, intensive cultivation and seed selection. But all of these countries have populations that are increasing by leaps and bounds and all of these extra months have to be filled. The increasing demand, therefore, tends to outdistance the ability to meet it. It is met only by drawing on the surplus of Burma, Siam and Indo-China including Cambodia and Tonkin.

The available supply for export from these countries is over 5,000,000 metric tons of which Burma furnishes the major portion. Where does this rice go ? India absorbs the greater part of Burma's surplus and the balance goes mainly to Europe. Siam supplies large quantities of rice to Europe also and gives the balance to Java, The Straits Settlements and Japan. Indo-China supplies China Japan and the Philippines.

The Philippine Islands have to support over two million people by direct importation. Java needs about 520,000 tons annually; Japan needs 450,000 tons, and the demand is increasing at an alarming rate in spite of efforts to meet the need through home production with scientific cultivation. China is always in the market for every ton she can find the means to import. India's periodical famines, China's disastrous floods, and the crop failures throughout the orient, soon wipe out this seemingly huge surplus of 5,000,000 tons. The rice problem bids fair to remain a perennial question of scarcity.

Possibilities of Increase

The land suitable for rice growing is limited to those sections of the world that have the climate and water facilities necessary to mature the crop. China, Java and Japan have every available meter of rice land already under cultivation. No land goes to waste in these industrious agricultural countries. Java could supply its rice shortage for a time by converting its sugar lands into rice lands but this is not practicable from an economic standpoint.

Burma with its heavy export may still increase its area by approximately eighteen per cent. Siam with an annual export of over one million tons may increase her area twenty per cent. In Cochin-China the area was increased during the decade 1898-1908 by 48,000 hectares annually, but for the period 1908-1914, the average annual increase was only 3,483 hectares and since that much less. Tonkin can increase its area by fifteen per cent. but as its export is now only 200,000 tons and its population is increasing rapidly it will soon cease to be a factor.

Annam holds little or no possibility of an increase. The Dutch East Indies have very great possibilities and these will be taken care of by the millions of Java who will soon have to spread out over neighboring islands. There are large areas in Sumatra, Borneo, Celebes and Papus which have the proper climatic conditions but which lack the labor. In time these lands should yield the same high hectare-production of Java and like Burma and Cochin-China become one of the world's great storehouses of food for the hungry masses.

Outside of this restricted area there are many other possibilities that have appeared upon the horizon of the student of the rice industry. The lands of Mesopotamia will, no doubt, be opened up when the irrigation schemes of Wilcox can be realized. The area is considerable and if the high production of Egypt is maintained the result should give a healthy annual surplus which ought to be available within the next decade. By augmenting and enlarging its irrigation projects, India can increase enough to offset its growing population, but annual imports can probably not be reduced.

The growing of rice in Queensland, Australia, seems to have been largely abandoned for several years due, no doubt, to the inability to secure cheap labor to compete witho ther rice-producing countries. There is sufficient land suitable for rice in Northern Australia to supply an export of millions of tons, if irrigation together with modern machinery could be supplied. This would be a natural consequence of letting down the bars and peopling North Australia with orientals accustomed to life in this hot, torrid section and skilled in the production of the cereal.

As to other parts of the world, we have the potentialities of Africa as in Soudan, where irrigation projects are now being pushed to completion for the growing rice of and cotton in the area between the White and Blue Nile. British, and former German East Africa, as well as the Portuguese colonies east and west, Kameroon, Nigeria and parts of the Congo region are suitable for rice, and hold forth future possibilities of production. South America also responds very well to the growing of this cereal. Already Brazil exports now over 50,000 tons to Europe and Argentina and Peru are rice-producing countries. Large tracts of rice land are found also in Central America, the United States and Europe.

A Question for Statesmen

From this it is readily seen that the world is quite capable of supporting its growing populations for many years to come. It is not really a question of restricted possibilities so much as proper utilization of resources. Mankind has been amply provided for in way of natural advantages. It remains for the human forces to so direct their energies that Mother Earth may yield up its wealth in sufficient quantities to sustain its teeming millions.

It is a question for statesmen. Unless nations can produce not alone political leaders, military leaders and financial leaders, but astute economic leaders they will labor under a handicap that will make the race increasingly difficult. Wise fathers prepare for the future and nations must do likewise or perish. The war's destruction like that of a storm aroused the world to a sense of its future responsibilities. The peoples who have learned the lesson are the one's that will survive the ordeal of reconstruction. It is a question of economic leadership.

The fallacy of placing transitory ignorance in positions where a wide range of knowledge and long training is necessary will become more apparent as the national food problems grow more acute. National leaders will more than ever be forced to concentrate upon those vital questions that deal with the alimentation of their nationals—increased production, irrigation, reclamation, multiple cropping, fertilization and adequate distribution—or their future and that of their country will be thrown in the balance.

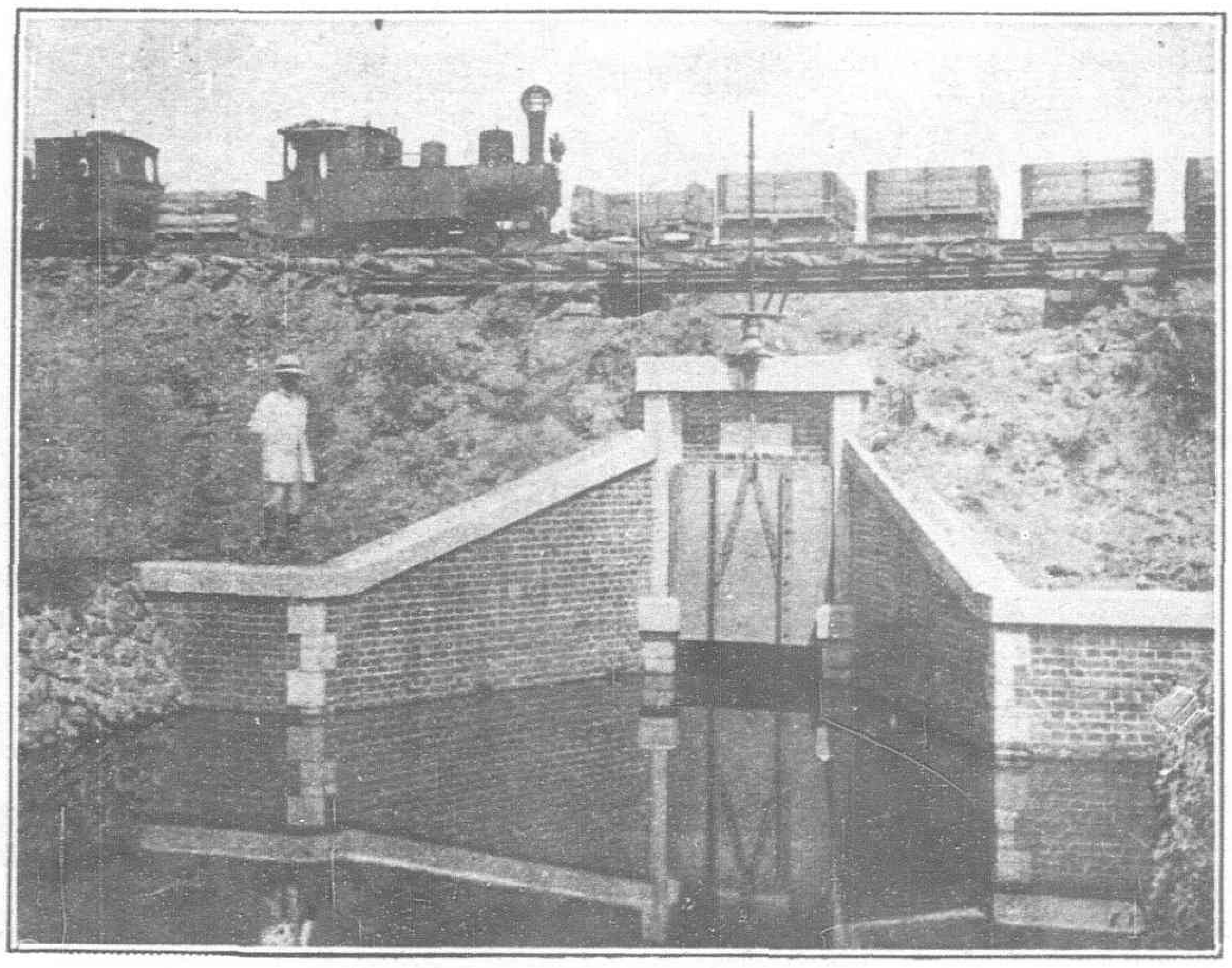
The work accomplished by the Dutch in Java, the French in Indo-China, the English in Egypt and in Burma points the way to the proper solution of the problem. Men of vision like Lord Cromer in Egypt and Sir Willcox in Mesopotamia will arise to lead the way to greater production and increased prosperity. Streams that are now finding their way to the sea without benefiting anybody will be diverted over the land and the arid regions of the earth will yield forth an abundance. A mere fraction of the world's wealth and energy which was consumed in the late war if turned into productive channels such as these will insure a bountiful supply for all time. And the fruits of the harvest will produce a nation of home builders with strong, progressive communities that will stand in defiance of time through the struggle of the centuries.

River Improvements in Japan

The Watarase Gawa Contract

THE Watarase is the largest of the branches of the Tone Gawa, its zone covering an area of 597 square miles. It runs through Tochigi prefecture, to the north of Tokyo, and three other densely populated prefectures in the east of Japan. Although the main stream is not more than 67 miles long, the total length of all its tributaries is 530 miles, and of this total something like 87 miles are navigable. With its branches, it drains a basin of something like 57,965,000 *tsubo*, but in flood spreads over 137,601,000 *tsubo*.

In the upper regions of the Watarase, there are many places where there are no embankments, or where the bank is not continuous, so that flood waters overflow into the surrounding fields. There are also many places where the river is unable to hold the full flood stream and with weak embankments. This is particularly the case where the Omoi Gawa meets the Watarase. At this point, the flow back from the Tone River rises, and the flood streams coming from the Tone, Watarase and the Omoi, break all embankments, and sweep the surrounding land over an average area of 30,000 *tsubo*. Making Akamaga swamp the centre of the flooded districts, the flood spreads over the central plain of this river basin. About 70 to 80 per cent. of the flooded basin is cultivated land, and as the floods last a long time, the lands are always severely damaged. In the past, the heaviest damages were experienced in 1896, 1902, 1906, 1910, and 1914; the losses being estimated at not less than Y.16,000,000 each year.



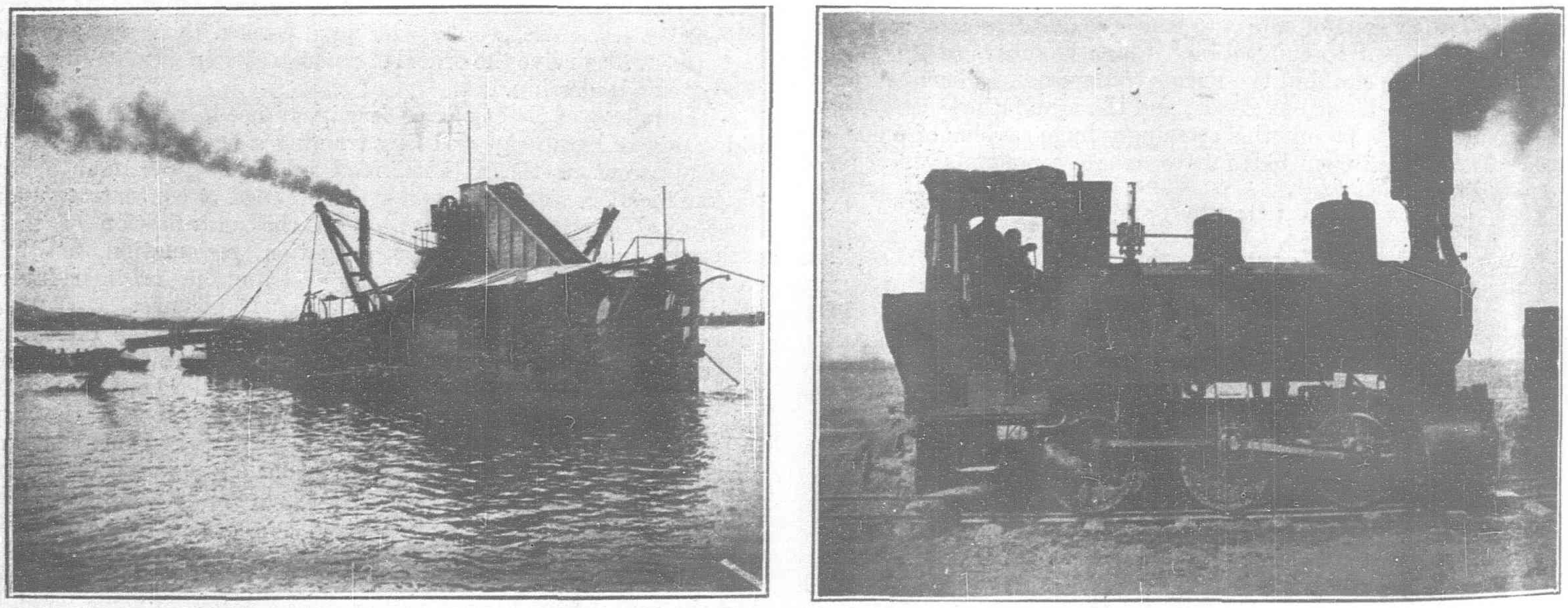
Ishikawa Sluice Gate, completed

Plan for Improvements

The program for improving this river has been spread over a period of 14 years, and the government has approved the original cost of Y.8,900,000, to which Y.2,500,000 was added in 1918 to meet the enhanced costs of materials and labor. The program provides for the improvement of the Watarase from Ashikaga, the great spinning centre, to where it meets the Tone River. The plan includes improvements to the three tributary streams of the Watarase, the Akiyama, the Omoi and the Uzuma. Up to April 1923, about 80 per cent. of the projected construction has been completed. The balance of the work is expected to be finished this year.

The main object of the improvements which have been carried out has been to hold back the flood streams. The work gives the rivers enough embanked space to allow a flow of 90,000 cubic feet a second at the highest in the Watarase River, and 60,000 cubic feet per second in the Omoi River. In connection with this work the curves in these river beds have been eliminated to a very great extent, and embankments raised.

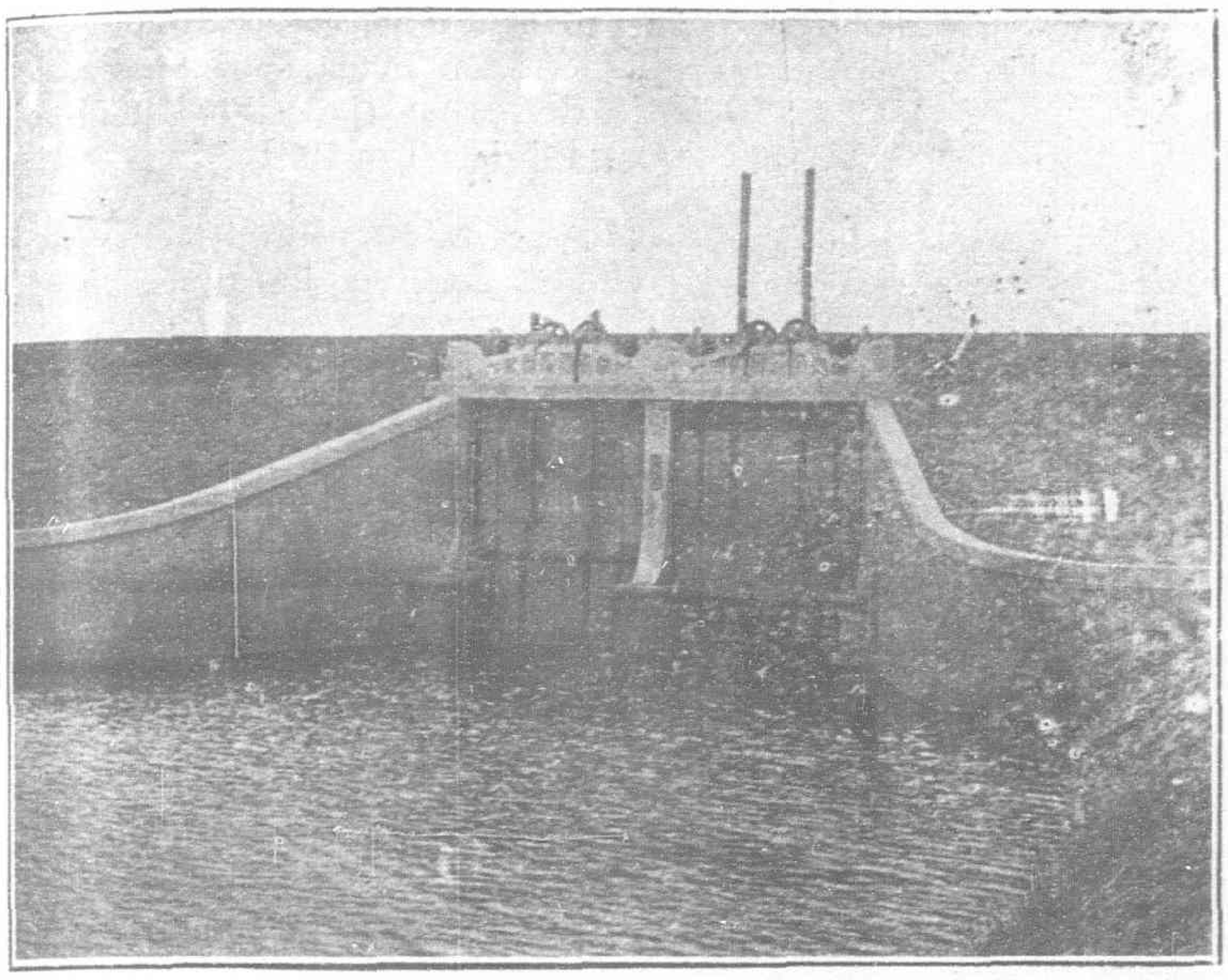
The curve in the Watarase from the town of Fujioka down stream is particularly sharp, so much so, in fact that there was found to be little room for improvement. Consequently it was determined to construct a new river bed, through the high land at Fujioka, which should empty into Akamaga swamp. It is into this swamp, or artificial reservoir, that the Omoi River and the Uzuma River are to be emptied after some straightening of their curves. In order to increase the capacity of the Akamaga swamp so that it will serve as a reservoir for the protection of the surrounding country in time of floods, the embankment of the old Yanaka basin has been removed, and both the Omoi and Uzuma Rivers have had their embankments at the points where they meet the Watarase River, removed. Instead of these old embankments a very much wider basin has been constructed, with a strong embankment around it. This new basin is 3½ miles wide, and 43¾ miles long, and its total



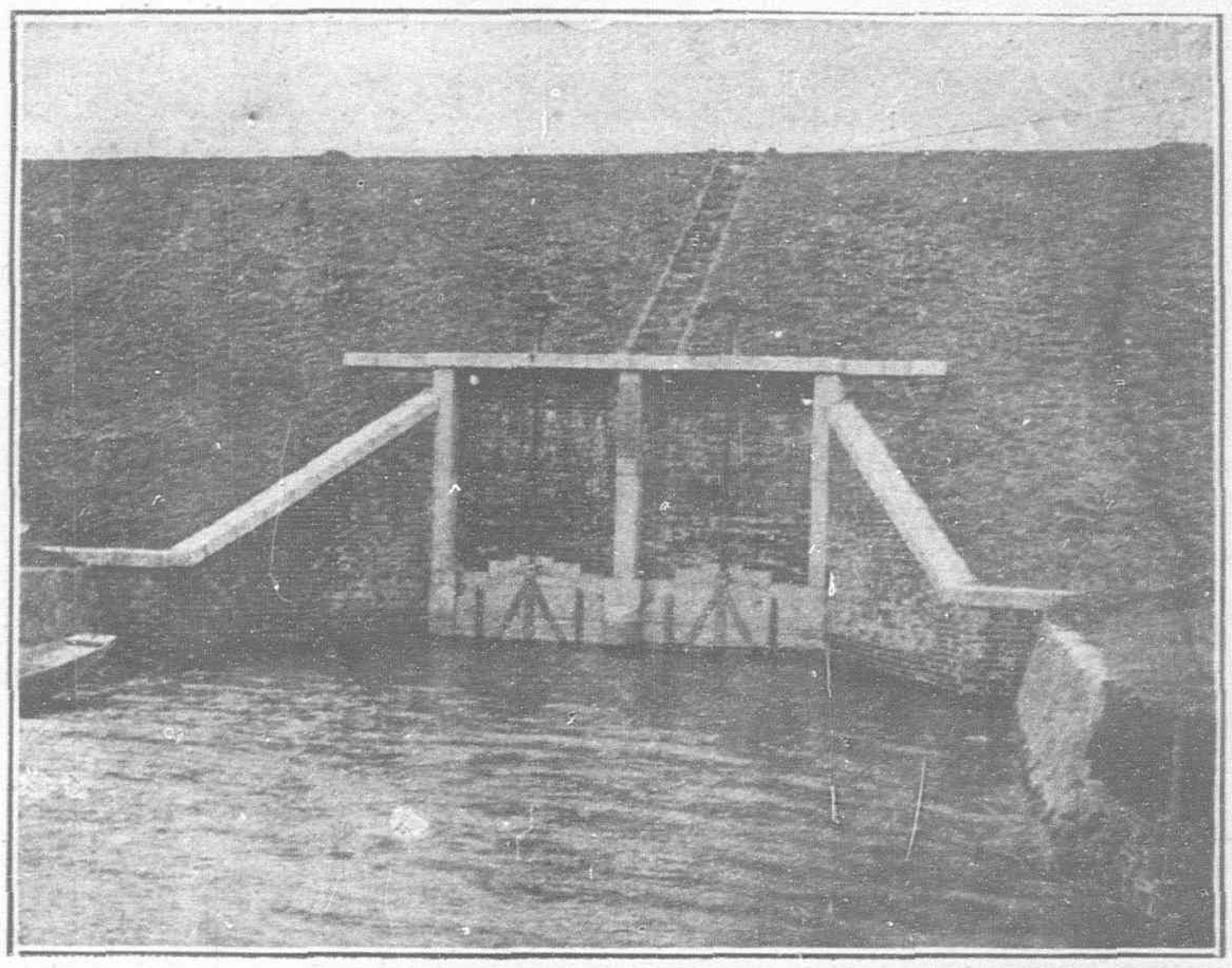
THE WATARASE RIVER IMPROVEMENTS

Dredger "Mikamo"

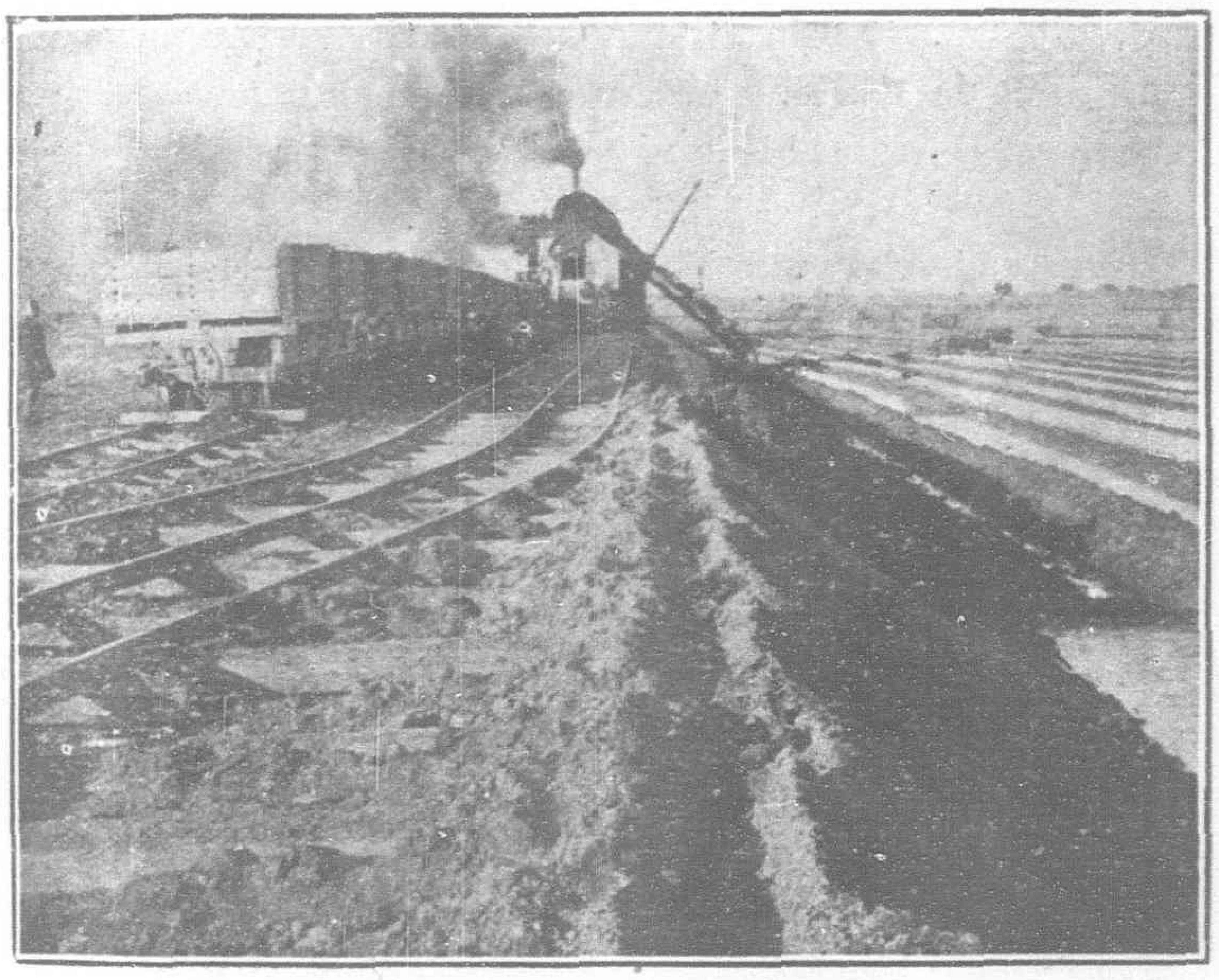
20-Ton Locomotive used on Work



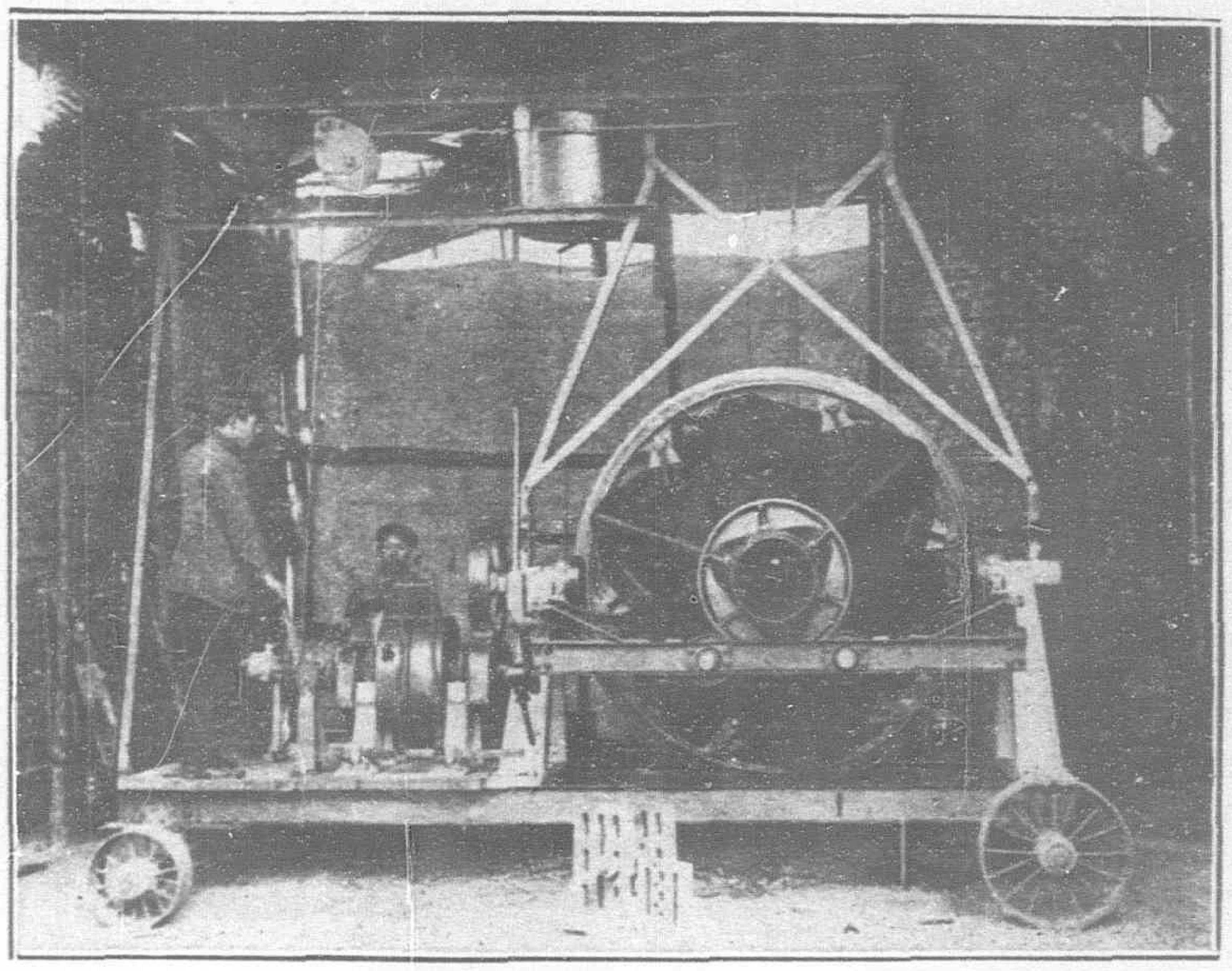
Yatagawa Sluice Gate



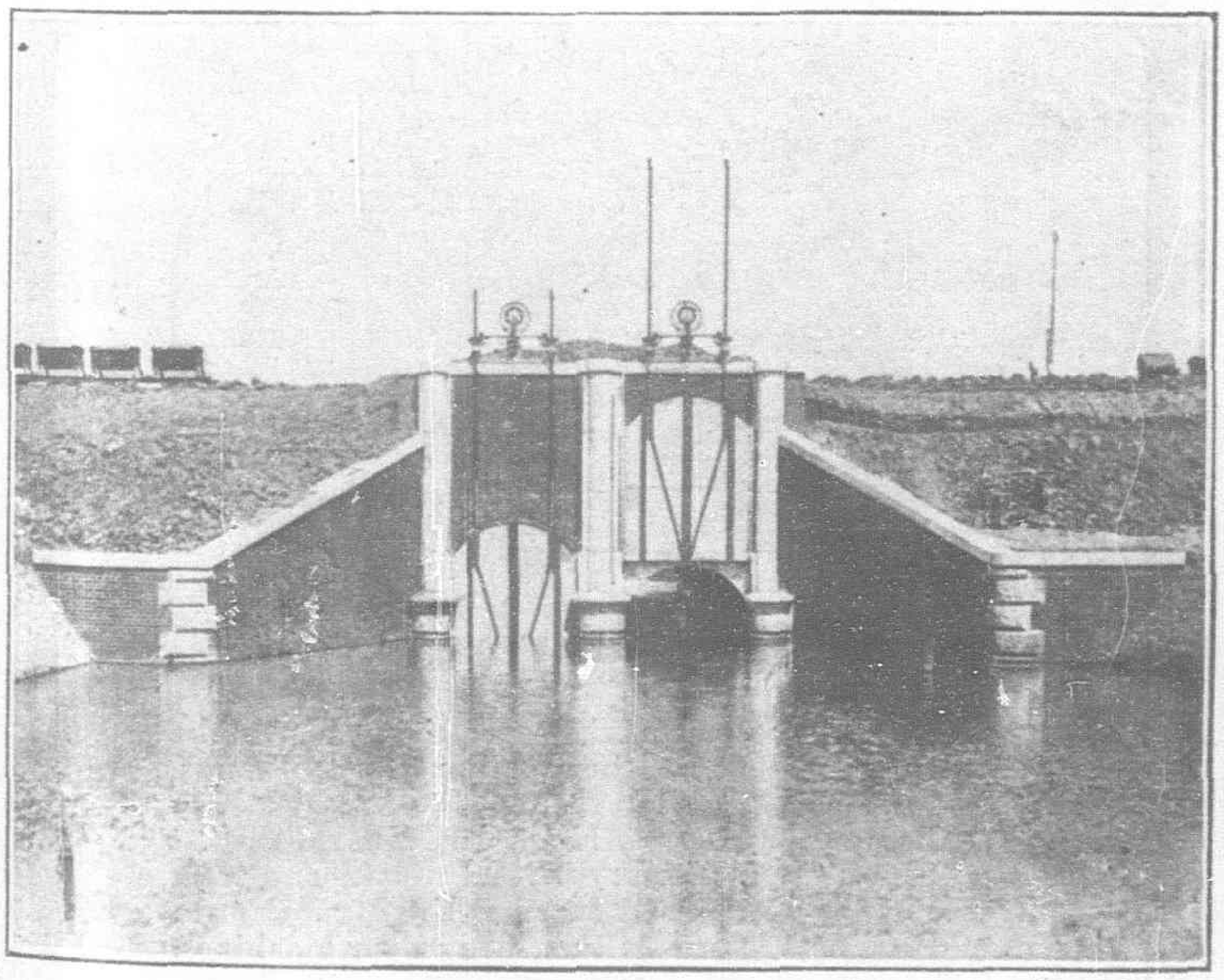
Hongo Sluice Gate



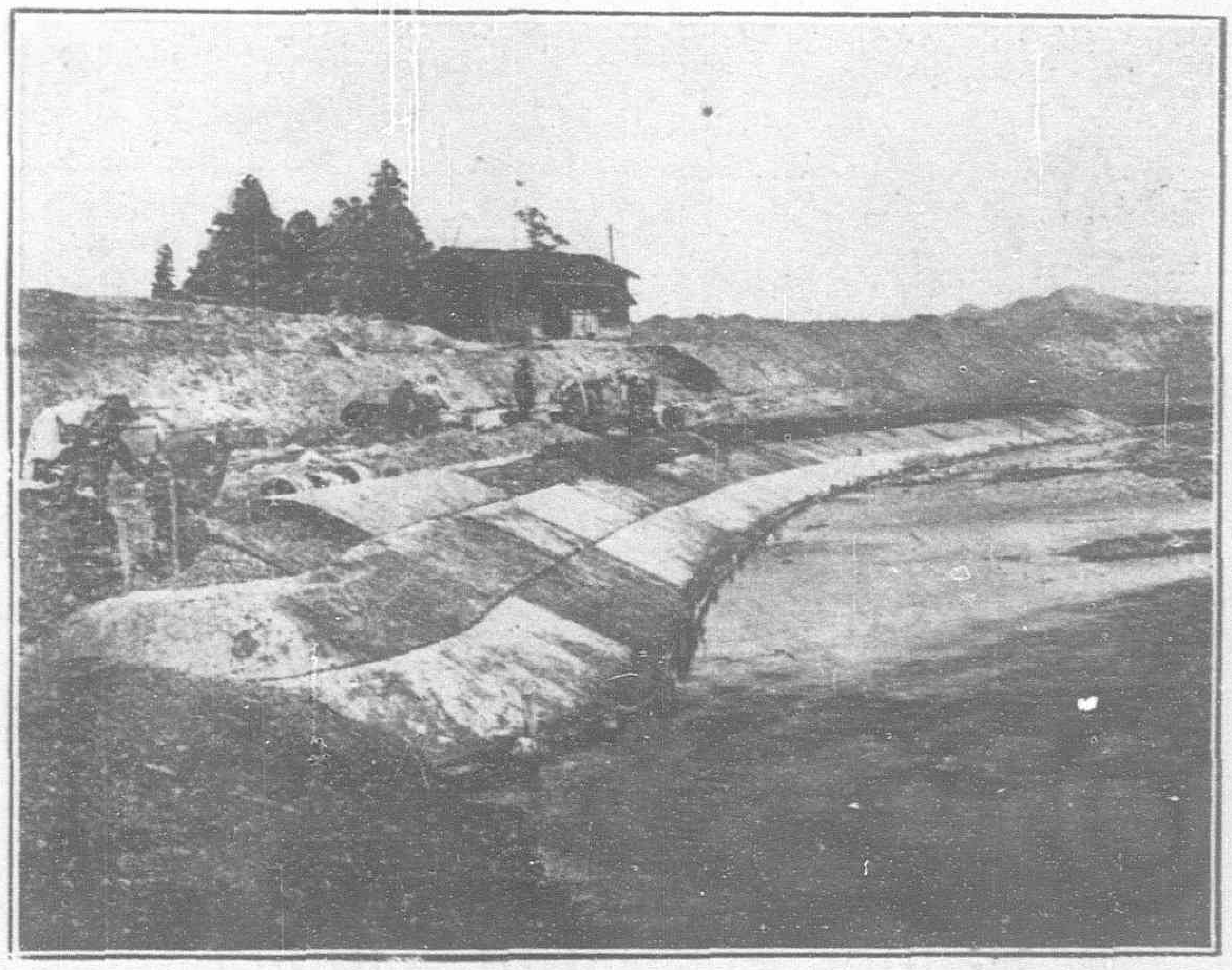
Mechanical Digger at Ishikawa



Cement Mixer



Yoragawa Sluice Gate



Reinforced Concrete Embankments

area is something like 10,596,000 *tsubo*. At the highest water level, some 19.6 feet, at Horiguchi, in Fujioka the basin, or flood prevention reservoir, can hold six billion cubic feet of water. This greatly decreases the quantity of water which flows into the main stream of the Tone River, and naturally the flow back into the Watarase, Omoi and Uzuma Rivers too. The reservoir decreases the quantity of water in the Tone River, from Kurihashi down stream to the sea to 200,000 cubic feet. The curves in the Watarase River between Koga-machi to the outlet of the Watarase have been straightened out, and the new river bed will direct the waters of the Watarase directly into the Tone River.

The upper stream of the Watarase has been widened to 600 feet. Of course, this is the width provided for the flood stream, the actual river at low water being only a very small stream. This width will gradually be widened to 1,380 feet. At Fujioka at the opening of the new river bed the width has been decreased to 540 feet, because of its slope. At the entrance into Akamaga swamp it becomes more than 2½ miles wide, and is narrowed down again to 1,800 feet at Koga-machi, and 2½ miles down stream again, it meets the Tone River. The Omoi River has a width of 1,380 feet at Hozumi village, and is gradually widened until it empties into Akamaganuma reservoir lake.

From Fujioka down stream the Watarase Gawa, the Omoi Gawa, and the Uzuma Gawa along their entire streams, are being embanked with banks built 5 feet higher than the highest flood waters yet known. The top of the bank is 18 feet wide, and the slope of both sides is 20 per cent. On the main stream a side step 12 feet wide has been built in the embankment on the river side of the stream. The embankment of the reservoir from Fujioka to Koga-machi is built 6 feet above highest flood water level, and the top of this bank is 24 feet wide, with an outside slope of 20 per cent. down to the side step, which is built at a point 6 feet below the top, and 12 feet wide : from the step to the bottom the slope is 30 per cent. The outer slope of the embankment has a side step 12 feet wide, built 6 feet below the top. The inclination is 20 per cent. all the way down.

From Koga-machi to the outlet of the Watarase River, the height of the embankment is 5 feet above high water level. The width of the top of the embankment is 24 feet, and the outer and inner slopes are both at an inclination of 20 per cent. The river side of the embankment, however, has a side step 12 feet wide, built 6 feet below the top, and from this step down the inclination is 30 per cent. This is the same as the Tone River embankment.

The office in charge of the improvements is at Koga-machi, and the machine shop is maintained there also. The department of home affairs has furnished THE FAR EASTERN REVIEW with the following list of machinery which has been used in the construction work along the Watarase River:—

	Capacity	Number in use
Locomotives	20 tons capacity	5
Shovels	200 cubic *tsubo* in 10 hours	5
Dump cars	18 cubic feet	460
Dredgers	200 cubic *tsubo* in 10 hours	2
,,	50 cubic *tsubo* in 10 hours	2
Earth transporting boats	18 cubic feet	22
,,	20 cubic feet	100
Rails	60 pounds	4 miles
,,	30 pounds	15 miles
,,	9 pounds	27 miles
Dump cars, wood	7 cubic feet	950
,, ,, iron	5 cubic feet	1,050
Portable engines	8 h.p.	3
,,	2½ h.p.	2
Centrifugal pump	900 gallons per minute	3
,,	400 gallons per minute	3
Cement mixer	11 cubic feet	1
,,	9½ cubic feet	1
Inspection boat	9½ h.p.	1
,,	6 h.p.	1

(Does not include machine shop equipment.)

Shimonoseki-Moji Tunnel

THE tunnel under the Shimonoseki-Moji strait is one of the pet projects of the railway department to perfect through communication between the main island of Japan and Kyushu, now interrupted by the ferry service between the two islands.

The project still seems to be a matter of finance, and engineering consideration. Little progress has been made, but at the last session of the diet, it was estimated that the tunnel might be built at a cost of Y.29,300,000, and finished in 1931.

The railway department has appointed a committee to investigate and report on the problems of construction under the following headings :—

1. Is the tunnel to be driven as a single or double one ?
2. Shall the power used be electric ? If electric, how shall the tunnel be equipped, trains, power stations, etc.
3. If electrified shall the line be pantograph, or single trolley system ?
4. What grade shall be taken as standard ?
5. Where shall the entrance of the tunnel be located, in relation to the present railway stations and the ferry landings ?
6. Shall the straits be crossed by a bridge, or by an undersea tunnel ?
7. Where shall the central point of the tunnel be ?
8. What shall be the distance between the sea bottom and the top of the tunnel ?
9. Shall the tunnel be made of steel tubing, or shall it be built of concrete ?

These and other questions are now being considered, but no decisions are expected this year.

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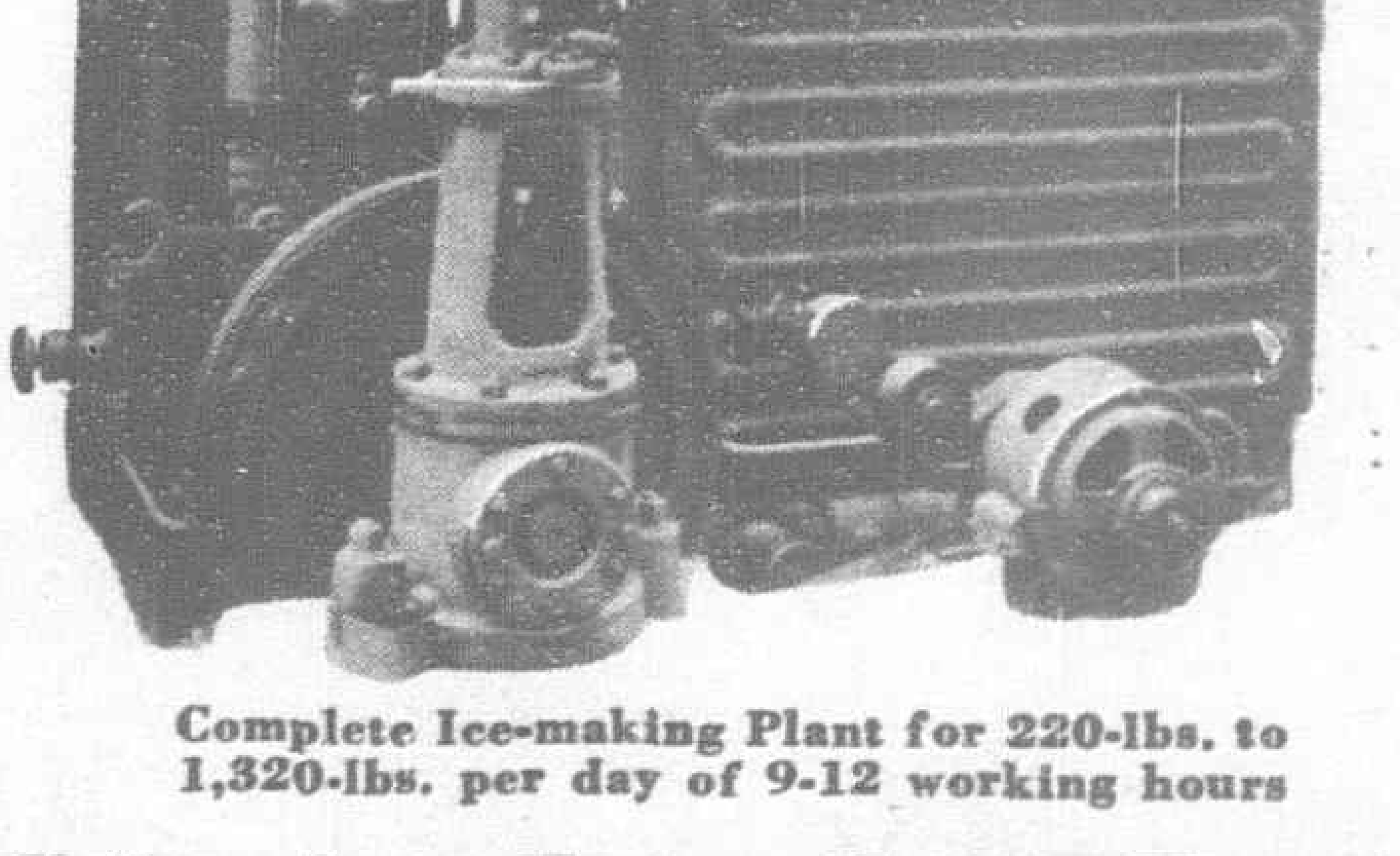

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